WATER RESOURCES
REPORT 2 - 3
GROUNDWATER SERIES

HYDROGEOLOGY
OF
BONAVISTA BAY AREA

BY
NOLAN, DAVIS & ASSOCIATES LTD.
ST. JOHN'S, NEWFOUNDLAND
1981

DEPARTMENT OF ENVIRONMENT
WATER RESOURCES DIVISION
ST. JOHN'S, NEWFOUNDLAND

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ABSTRACT

Within the Bonavista Bay area both surficial and bedrock aquifers of varying yields are relied upon for domestic and municipal purposes. Only two meaningful surficial hydrostratigraphic units have been identified; till and outwash sands and gravels form these units. The till comprising the ground and end moraine units is certainly the most widely utilized surficial or bedrock aquifer unit. No detailed information exists on the number, distribution or yield of the shallow dug wells within the till; however an average yield of less than 9 lpm (2 gpm) is estimated. The outwash sand and gravel deposits are much more productive with reported yields of 45 to 273 lpm (10 to 60 gpm) based on wells located at Terra Nova and Carmanville. If proper construction and development techniques were utilized substantially higher yields could be expected. Outwash sands and gravels and deltaic deposits are only locally extensive, their usefulness as aquifers will be largely determined by the saturated thickness.

The sedimentary sequences of the extensive Musgravetown Group forms Hydrostratigraphic Unit 5, it is the most productive bedrock aquifer with a mean yield of 28.6 lpm (6.3 gpm). Based largely upon drilled well data, four other hydrostratigraphic units have been characterized;

the estimated range in yield for these units is 5 to 26.4 lpm (1.1 to 5.8 gpm). A total of 559 wells have been compiled for the study area, of these 390 were utilized in characterizing the bedrock hydrostratigraphic units. Generally 30 - 40% of these wells have yields between 0 - 4.5 lpm while yields of more than 45 lpm (10 gpm) were estimated for approximately 8% of the wells. The estimated mean yields for the bedrock hydrostratigraphic units are generally capable of meeting only domestic needs. Units 4 and 5 are potentially capable of satisfying restricted municipal and industrial demands. Proper siting, construction and development of bedrock wells could achieve substantial increases over the yields typically reported for these units.

Although seven hydrometric stations are found within the study area, only the Terra Nova River at Eight Mile Bridges and Middle Brook near Gambo had meaningful periods of record for calculating the ground water flow component. Minimum monthly flows for each water year of record were used to determine the volume of ground water discharged to both these basins. Use of mean daily hydrograph records for the mean flow year confirmed these values. The calculated minimum annual values of 184 and 215 mm (7.2 and 8.5 in) for the Terra Nova and Middle

Brook Basins, probably best reflect actual ground water recharge because of the large volumes of surface water within these basins.

With the exception of occasional iron problems, ground water quality is generally quite good for Hydrostratigraphic Unit 5 and the other units for which data exists; however, this is based on limited data. Virtually no water quality data exists for the surficial aquifers. Contamination of wells, especially dug wells, by sewage effluent and road salt are the main problems within the Bonavista Bay area. These problems are enhanced by construction practices utilized in establishing dug or drilled wells. The amount of casing being utilized in most drilled wells is totally inadequate, while construction techniques used in developing drilled wells within surficial materials are not suitable. Sea water intrusion is likely a problem within the Bonavista Bay area but it is less well defined.

Potential exists for substantially increasing yields in surficial and bedrock aquifers if attention is given to proper construction and development practices.

1 INTRODUCTION

The firm of Nolan, Davis & Associates was engaged by the Province of Newfoundland and Labrador under the direction of the Department of Environment, to study and prepare a report on the hydrogeologic conditions in the area of Bonavista Bay.

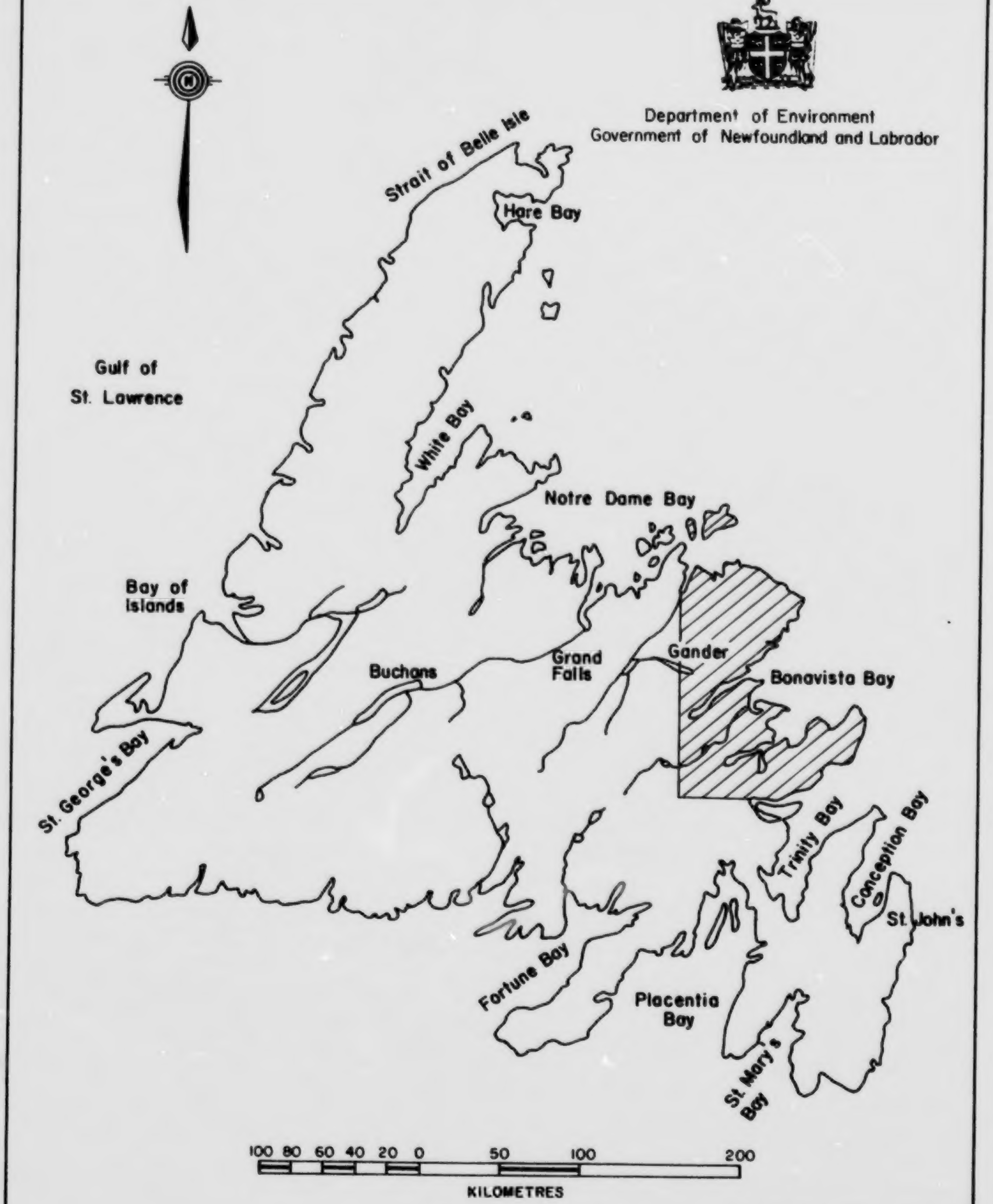
This publication is the third in the Department of Environment's Water Resources - Groundwater Series. It continues the efforts of the Water Resources Branch to characterize and subsequently better understand the hydrogeologic resources of the province; consequently this will increase the usefulness of the resources to the province. The study was basically designed to identify and interpretate existing data.

1.1 Scope of Study

The hydrogeological study of the Bonavista Bay area was conducted within the guidelines provided by the Department of Environment. The study objective was to determine the physical characteristics of the major geologic units in relation to the occurrence, availability and quality of the constituent ground water; and to define these units in terms of their aquifer potential. To meet this objective: 1) the physiography and surficial and bedrock geology were described; 2) available reports, drilled well records and previous experience within the study area were used to define and characterize the hydrogeological potential of the surficial and bedrock geological units; 3) a total of three maps, at a scale of 1:250,000, were prepared; they detail the bedrock geology, surficial hydrogeology and bedrock hydrogeology.

1.2 Location

The study area is located on the eastern coast of the Island of Newfoundland, north of the Avalon Peninsula and surrounds Bonavista Bay on three sides (see Figure 1-1). The western boundary is defined by the 54° 30' line of longitude and runs southward from Gander Bay until it intersects the 48° 14' (approximate) line of latitude. The 48° 14' (approximate) line of latitude continues eastward to Georges Brook, and then continues north of Random Island, through Smith Sound. Thus the Bonavista Bay study area encloses everything north of Smith Sound and the 48° 14' (approximate) line of latitude, including Fogo and Change Islands and everything east of the 54° 30' line of longitude to Bonavista Bay (see Figure 1-2). It encompasses most of the Fogo, Terra Nova, Bonavista North and South and part of the


Department of Environment
Government of Newfoundland and Labrador
Strait of Belle Isle
Hare Bay
Gulf of St. Lawrence
White Bay
Notre Dame Bay
Bay of Islands
Buchans
Grand Falls
Gander
Bonavista Bay
St. George's Bay
Trinity Bay
Conception Bay
St. John's
Fortune Bay
Placentia Bay
St. Mary's Bay
100 80 60 40 20 0 50 100 200
KILOMETRES

HYDROGEOLOGY OF BONAVISTA BAY AREA

Figure 1-1

Location plan of study area

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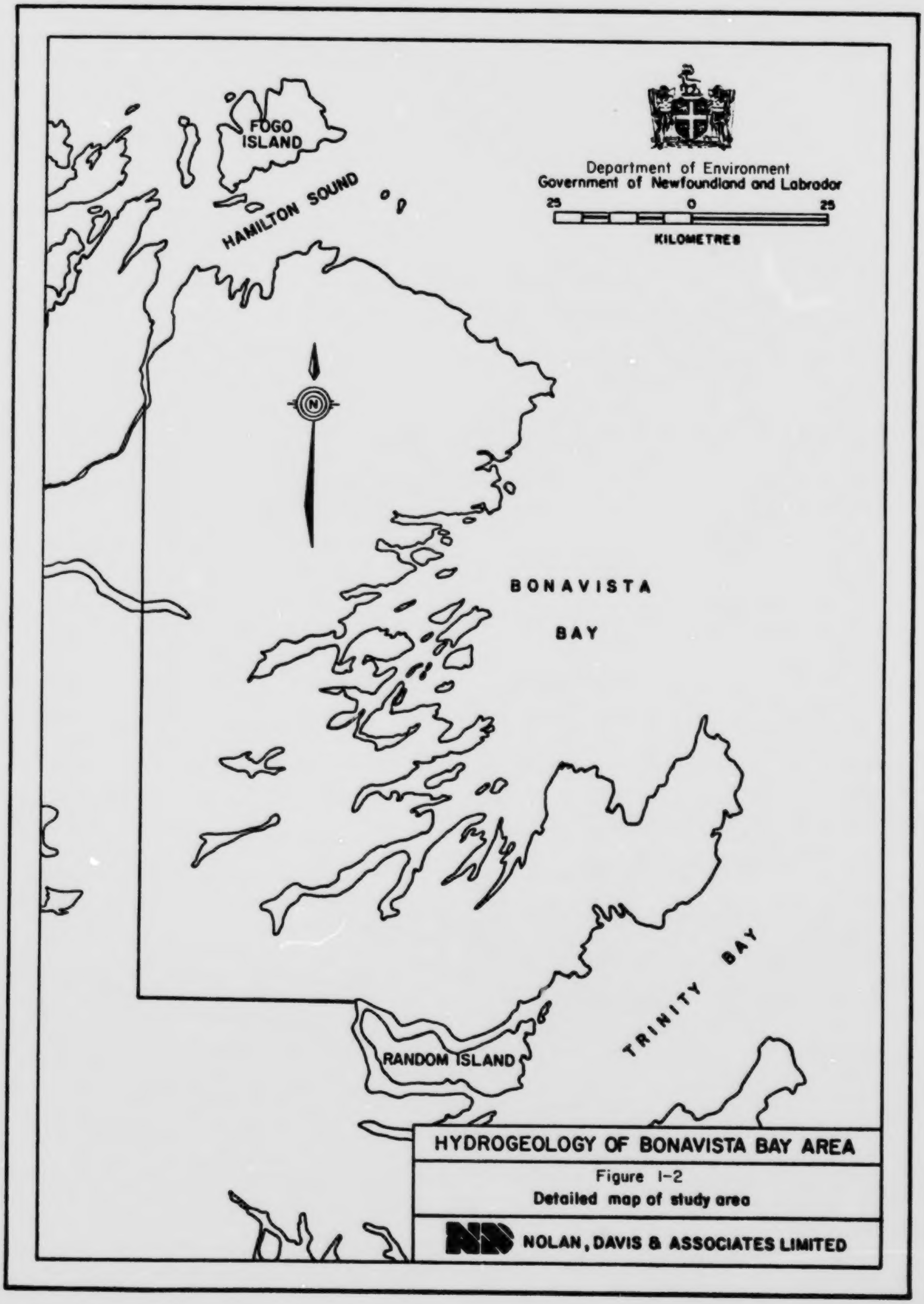
FOGO ISLAND
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BONAVISTA BAY
TRINITY BAY
RANDOM ISLAND

HYDROGEOLOGY OF BONAVISTA BAY AREA

Figure 1-2

Detailed map of study area

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Trinity North electoral districts. It is covered either entirely or partially by the following 1:250,000 and 1:50,000 National Topographic System (NTS) Maps:

1:250,000 - 2C
- 2D
- 2E
- 2F

1:50,000 - 2C - 4/5/6/11/12/13
- 2D - 1/8/9/16
- 2E - 1/8/9
- 2F - 3/4/5

1.3 Population and Economy

Based on 1976 census data, Statistics Canada has estimated that a total population of 45,740 exists within the boundaries of the study area. Table 1-1 details the main population centers within the study area, these centers represent only 59% of the total population. These figures indicate the rural and small community nature of the population within the Bonavista Bay area. In nearly all cases both the large and small population centers are located along the coast.

The economy of the Bonavista Bay study area centers on the fishing, tourism and forest industries. The

TABLE 1-1

POPULATION CENTERS

Community	Population
Badgers Quay	1,468
Bloomfield	677
Bonavista	4,299
Carmanville	911
Catalina	1,129
Dark Cove (includes Gambo & Middle Brook)	2,994
Dover	960
Elliston	540
Fogo	1,103
Gander Bay	331
Glovertown	2,176
Hare Bay	1,598
Joe Batt's Arm	1,023
Lethbridge	736
Little Catalina	736
Little Seldom	522
Lumsden	597
Musgravetown	641
Newtown	490
Port Blandford	815
Port Union	678
Seldom	522
Trinity	367
Valleyfield	595
Wareham	505
Wesleyville	1,167
TOTAL	27,580

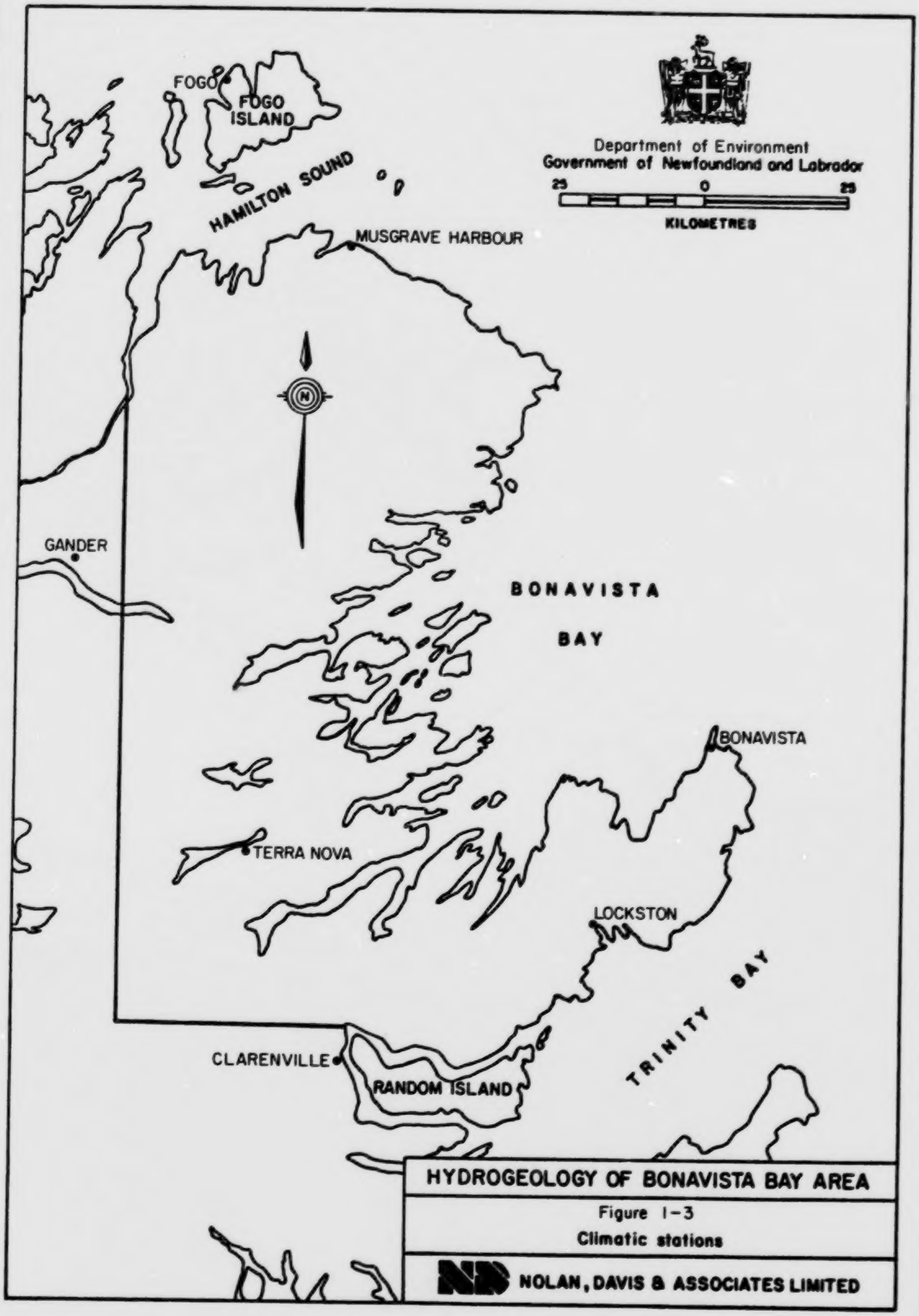
economic base provided by the fishing industry includes the inshore fishery; fish processing, ship construction and repair; and related supply industries. The tourism industry centers around the Terra Nova National Park, numerous provincial parks and various quaint Newfoundland communities within the study area. Most of the activity within the forest industry relates only to harvesting and shipping of pulp to manufacturing centers.

1.4 Climate

1.4.1 Introduction:

The climate of the study area can be considered as marine due to the pervasive influence of the ocean on all regions of the Bonavista Bay area. The climate is characterized by cool temperatures and moderately high total precipitation.

Five climatic stations are located within the study area while the Gander and Clarenville stations lie immediately to the west and south respectively (see Figure 1-3). Long periods of recent climatic data exist for the Gander and Terra Nova stations; these are the major stations in the area of Bonavista Bay. Although there is a long period of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Government of Newfoundland and Labrador
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KILOMETRES
FOGO
FOGO ISLAND
HAMILTON SOUND
MUSGRAVE HARBOUR
N
GANDER
BONAVISTA
BAY
BONAVISTA
TERRA NOVA
LOCKSTON
TRINITY BAY
CLARENVILLE
RANDOM ISLAND

HYDROGEOLOGY OF BONAVISTA BAY AREA

Figure 1-3

Climatic stations

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of record (1874 - 1950), the data from the Fogo station is considerably older. Except for the Lockston station, all stations have both mean daily temperature and mean monthly total precipitation data; evapotranspiration data exists for both the Gander and Bonavista stations.

1.4.2 Temperature:

With the exception of Lockston, monthly summaries of mean daily temperature data were available for all the stations. Table 1-2 provides a mean monthly temperature summary of all daily temperature data for each station. For the period of record, the mean monthly temperatures range from -7.7 to 16.5^{O}C (18.1 to 62^{O}F) while the annual mean monthly temperature varies from 3.9 to 5.4^{O}C (39.0 to 41.7^{O}F). The lowest mean monthly temperature recorded was -14.1^{O}C (6.6^{O}F), it was recorded in February of 1923 at Fogo; the highest was 22.7^{O}C (72.9^{O}F), it was recorded in August of 1967 at Bonavista. Generally sub-zero temperatures predominate throughout the study area during the months of January, February, March and December; near zero temperatures prevail in April and November. The warmest months are June, July, August and September; July usually has the highest temperatures.

TABLE 1-2

MEAN DAILY TEMPERATURE (°C)

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	MEAN ANNUAL	DURATION
BONAVISTA	-3.8	-4.5	-2.6	0.6	4.5	9.2	14.6	15.1	11.7	7.3	3.8	-0.9	4.6	1956-1972
CLARENVILLE	-3.5	-5.2	-1.9	2.1	7.2	12.9	16.2	15.5	11.5	7.0	2.4	-2.8	5.1	1978-1980
FOGO	-6.4	-7.8	-3.9	0.6	5.3	10.6	15.3	15.1	11.9	7.0	1.9	-2.9	3.9	1874-1950
GANDER INTERNATIONAL AIRPORT	-6.1	-6.3	-3.5	0.8	6.3	11.4	16.5	15.8	11.8	6.3	1.9	-3.4	4.3	1941-1970
MUSGRAVE HARBOUR	-4.8	-7.7	-1.2	1.5	6.8	14.1	16.1	14.2	10.9	6.2	3.0	-2.9	5.2	1979-1980
TERRA NOVA	-5.5	-6.5	-2.4	1.5	6.3	11.5	16.1	15.7	11.6	6.5	2.1	-3.0	4.5	1962-1980

1.4.3 Precipitation:

Total precipitation data was available for all seven stations within and adjacent to Bonavista Bay. In Table 1-3, the monthly summaries of the total precipitation data are arranged for the entire period of each station's record. From this summary, the total precipitation data ranges from 50.6 to 147.7 mm (2 to 5.8 inches); while annual total precipitation ranges from 892 to 1176.8 mm (35.1 to 46.3 inches). Considering the entire period of record for each station, the lowest recorded monthly value was 3.6 mm (.14 inches) and was recorded at Fogo in August of 1930; the greatest value of 298.2 mm (11.7 inches) was recorded in February of 1962 at Gander. Generally most precipitation falls during the months of October, November and December while the least precipitation falls during April, May, June or July. The inland climatic stations usually receive in excess of 1100 mm (43.3 inches) of precipitation annually while the stations on the coast generally receive an amount equal to or less than 1000 mm (39.4 inches).

1.4.4 Evapotranspiration:

This refers to the amount of moisture lost to the atmosphere by evaporation from surface water bodies; soil surfaces and from the soil by plant transpiration.

TABLE 1-3

TOTAL PRECIPITATION (mm)

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	MEAN ANNUAL	DURATION
BONAVISTA	93.0	101.1	93.5	68.8	66.5	65.0	59.4	85.6	80.3	94.5	105.7	97.3	1010.7	1956-1972
CLARENVILLE	104.3	65.0	107.3	50.6	82.6	56.7	100.8	108.3	147.7	137.4	128.8	100.3	1189.8	1978-1980
FOGO	90.4	97.5	88.9	61.2	62.0	61.0	69.6	67.3	79.5	88.6	78.5	88.4	932.9	1874-1950
GANDER INTERNATIONAL AIRPORT	94.0	100.8	96.8	85.1	62.5	76.2	77.7	100.8	84.1	95.3	106.9	98.0	1078.2	1941-1970
LOCKSTON	30.5	74.9	78.7	76.7	91.7	81.8	80.5	129.8	96.0	137.4	145.5	80.0	1103.6	1966-1972
MUSGRAVE HARBOUR	94.2	57.5	62.3	33.8	67.4	56.1	80.4	99.8	87.0	79.9	101.5	72.1	892.0	1979-1980
TERRA NOVA	95.8	97.1	106.1	87.4	94.2	74.1	82.5	105.8	99.4	111.0	111.8	111.6	1176.8	1962-1980

Evapotranspiration is reported as either potential or actual evapotranspiration; both are based on a theoretical calculation of the amount of moisture that could be lost given the proper conditions. Environment Canada - Atmospheric Environment Service, has both potential and actual evapotranspiration data available for the Gander International Airport and potential evapotranspiration data for the Bonavista station. The potential and actual evapotranspiration values are both calculated using the method developed by Thornthwaite (1948). The data presented assumes that 100 mm of soil moisture is available for evapotranspiration.

Calculated lake evaporation data, based on the use of evaporation pans, is presented for the Gander station. The applicability of calculated lake evaporation data in "wet" areas, where ground water recharge is not a concern, surpasses the usefulness of theoretically calculated evapotranspiration values. In some areas, it is realized that substantial differences can exist between the amount of evapotranspiration that occurs and the theoretical value calculated for potential and actual evapotranspiration. This fact has a considerable effect on the solution of the water balance equation. Table 1-4 presents the available data and illustrates the differences between the theoretical evapotranspiration and lake evaporation data.

TABLE 1-4

EVAPOTRANSPIRATION (mm)

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
GANDER INTERNATIONAL AIRPORT													
POTENTIAL[1]	0	0	0	9	50	80	122	122	80	43	24	0	518
ACTUAL[1]	0	0	0	9	50	80	115	112	80	43	24	0	512
BONAVISTA													
POTENTIAL[1]	0	0	0	9	50	81	112	103	72	50	23	0	500
ACTUAL[1]	0	0	0	9	50	80	95	93	72	50	23	0	471

GANDER INTERNATIONAL AIRPORT - CLASS "A" EVAPORATION PAN DATA (mm)

YEAR													TOTAL
1972	-	-	-	-	-	-	119.4	92.2	52.1	-	-	-	263.7
1973						89.4	97.5	72.1	68.6	-	-	-	327.6
1974						113.8	97.5	75.7[2]	59.2[2]	-	-	-	346.2
1975						91.9	132.8	95.3	54.1[2]	-	-	-	371.1
1976						-	105.4	112.8	53.3	-	-	-	271.5
1977						-	127.8	109.0	62.0	-	-	-	298.8
1978						106.0[2]	129.2	116.2	-	-	-	-	351.4
1979						131.2	118.9	89.6	78.0	22.0	-	-	439.7
1980						96.8[2]	79.7	85.1	71.1	-	-	-	332.7
MEAN						104.9	112.0	94.2	62.3	22.0	-	-	-

1 - Assumes 100 mm of soil moisture

2 - Estimated value

Within the study area evapotranspiration is highest during the months of June, July and August.

1.5 Previous Work

Prior hydrogeological work within the Bonavista Bay area was virtually non-existent. Exceptions existed for very specific site investigations and included a study entitled "Terra Nova Regional Waste Disposal Site" by J. R. Robinson and R. Lethbridge (1979) for the Department of Environment. In addition, an investigation of well problems at Appleton and a ground water appraisal for the Town of Trinity in Bonavista Bay were conducted by Nolan, Davis & Associates for the Department of Municipal Affairs and Housing. Information from various aquifer tests throughout the study area were also provided by Nolan, Davis & Associates. Further hydrogeological information, of a general nature, was provided in the Water Resources Study of the Province of Newfoundland and Labrador for the Atlantic Development Board by Shawinigan Engineering Limited and James F. MacLaren Limited (1968). The information contained within the Water Resources Branch 1979 publication - "Water Well Data for Newfoundland 1950-1977" and additional well records from their files, provided the basis for the hydrogeological characterization of the

Bonavista Bay area.

Reports, information and maps from the Newfoundland Department of Mines and Energy and the Geological Survey of Canada provided the basis for development of the surficial and bedrock geology maps of the study area. Hydrometric and climatic data for the Bonavista Bay area, was obtained from Environment Canada - the Water Survey and Atmospheric Environment Service branches respectively.

1.6 Acknowledgements

This report was prepared by the staff of Nolan, Davis & Associates with advice from Dr. W. Ullah and J. Robinson of the provincial Department of Environment. The study and report were conducted under the supervision of F. Nolan; H. LeBlanc acted as chief investigator. R. Cottingham and F. Baechler were individually responsible for important sections of the report. F. Nolan and B. Davis provided specific information on the geology and hydrogeology characteristics within the study area. Maps, drawings and graphs were prepared and drafted by F. Garland. K. Garden-Rushton was responsible for all typing and assisted in organization of the report. The assistance of Messrs. W. and R. Byers was greatly appreciated in studying

the hydrology of the Bonavista Bay area.

Collection of data for the report was aided by the fullest co-operation of the following individuals:

W. Ullah - Department of Environment
J. Robinson - Department of Environment
D. Van deVeer - Department of Mines and Energy
D. Kirby - Department of Mines and Energy
Mr. Barry - Department of Public Health
Mr. Roswell - Department of Public Health
L. Warren - Department of Transportation
Mr. Noseworthy - Department of Transportation
W. Woodlock - Environment Canada - Water Survey
D. Snow - Environment Canada - Water Survey
J. Amirault - Environment Canada - Atmospheric Environment Services
M. Howe - Environment Canada - Atmospheric Environment Services
B. Fitzgerald - Statistics Canada
D. Cortnery - Statistics Canada

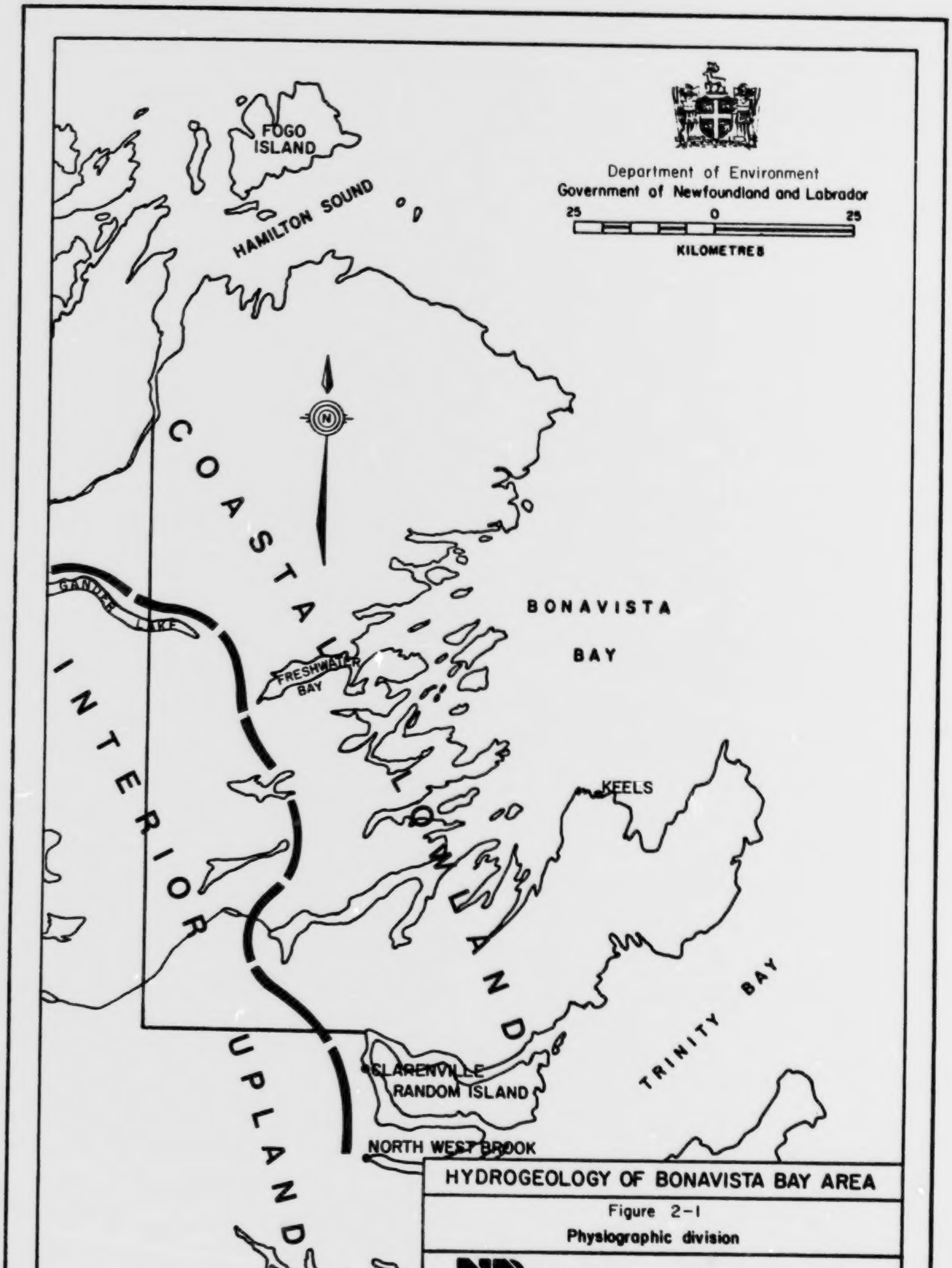
2. PHYSIOGRAPHY

2.1 Topography and Terrain

The physiography of Newfoundland has not been well studied except in specific areas which have been geologically mapped. Twenhofel and MacClintok (1940) published the first account of the physiography of Newfoundland in the Bulletin of the Geological Society of America. This paper, entitled "Surface of Newfoundland" acknowledged the earlier work of Murray and Howley (1881). It made special reference, however, to A. K. Snelgrove of the Geological Survey of Newfoundland, who had prepared a physiographic map of the island showing twelve divisions (1938). The Bonavista Bay study area was classified as Division 1 - "Atlantic Upland".

Although the study area has been described as part of the Atlantic Upland there are really two regional physiographic divisions within it: 1) the Coastal Lowlands and, 2) the Interior Uplands (see Figure 2-1). The Coastal Lowland generally occurs east of a line joining the east end of Gander Lake to Clarenville; the Uplands lie to the west of this line.

As described by Jenness (1963) the Coastal Lowlands generally lie below an elevation of 80 m (262.5 feet) Higher hills occur along two subparallel south-southwest trending ridges between Freshwater Bay and the Community of North West Brook; and between Keels and the east end of Random Sound.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HAMILTON SOUND
COASTAL LOWLAND
INTERIOR UPLAND
GANDER LAKE
FRESHWATER BAY
BONAVISTA BAY
KEELS
TRINITY BAY
CLARENVILLE
RANDOM ISLAND
NORTH WEST BROOK
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Figure 2-1

Physiographic division

The Interior Upland commonly has a flat to rolling topography with elevations exceeding 150 m (492 ft). However, several rivers cut through this plateau resulting in considerable variation in elevations - locally up to 180 m (591 ft). Elevations to the north and east of Gander Lake are generally less than 90 m (295 ft); to the south of the lake they increase and culminate in the topographic high which roughly parallels the 48° 10' line of latitude. Along this divide elevations are commonly in the range of 220 to 240 m (722 - 787 ft). A smaller topographic high occurs along the boundary of the Gander and Terra Nova Rivers and the Gambo Pond Basin. Locally, areas will attain high elevations and produce considerable relief due to highly resistant geological formations.

Soils are poorly developed due to the cold climate and extensive glaciation to which the entire region was subjected. Ground moraine is common throughout the study area, but is typically less than 5 m (16 ft) thick. Its composition varies according to the underlying bedrock. Almost the entire coastline exhibits bare rock outcrop and supports little in the way of vegetation. Extensive areas of barren and boggy terrain exist, especially on the peninsula between Bonavista Bay and Gander Bay. Evergreen growth thickens inland and large areas have been harvested for pulpwood to supply the newsprint industry. This is especially true in areas to the west of the railway, between Port Blandford and Gander.

2.2 Drainage

The study area is drained to the north and east by numerous streams and rivers. The most readily drained land exists near the coast due to the thinner overburden and the rugged relief - especially where bedrock is exposed. In these locations, many of the streams are small due to the limited areas of the peninsular land masses. The largest rivers draining the region are the Terra Nova River, Indian Bay Brook and Gambo Pond Brook. A small part of the study area, to the west and northwest of Gambo, drains into the Gander River system.

There is an enormous amount of surface water in the form of lakes and ponds within the peninsula between Gander Bay and Bonavista Bay. Some of the "ponds" are quite large, having areas of 10 to 15 km^2 (4 to 6 mi^2) and would be better described as lakes. These included Deadman's Pond, Ten Mile Pond and Indian Bay Pond.

The largest bodies of freshwater in the southern half of the study area are Maccles and Terra Nova Lakes; they are over 20 km^2 (7.7 mi^2) in area. Maccles Lake has a relatively small watershed which is limited to an area only slightly larger than the lake. The Terra Nova watershed, on the other hand, is one of the largest in eastern Newfoundland covering nearly 2000 km^2 (772 mi^2); approximately half of which is in the study area. Terra Nova Lake acts as a holding basin for spring runoff and is capable of rising approximately one metre during such periods. At such times it can store an additional 35 x 10^6 m^3 (7.7 x 10^9 gal) of water.

3. GEOLOGY

3.1 Surficial Geology

The entire study area was glaciated during late Pleistocene times; the last ice sheet advanced in a predominantly coastward direction. This ice sheet apparently radiated from a center located to the west in central Newfoundland. Nearly all the Bonavista Bay area is characterized by a veneer of glacial till ranging in thickness from a few centimeters to over 6 m (20 ft). The presence of these deposits is responsible for much of the rolling superficial topography within the study area.

Generally, inland portions of the study area offer a greater diversity of glacially derived materials than the Bonavista Peninsula and coastal areas. Inland, such deposits as ground moraine, end moraine, indicator boulders, eskers, kames, kame terraces, outwash and outwash deltaic sediments have all been identified. No end moraines, eskers, kames, or kame terraces have been noted either on the Bonavista Peninsula or along the coast of Bonavista Bay.

3.1.1 Morainal Deposits:

Ground moraine is found in many parts of the study area and forms a thin veneer throughout most inland portions. In the coastal and peninsula areas, the ground moraine is basically restricted to low lying regions between the many hills in these areas. The composition of the till forming the ground moraine typically reflects the nature of the underlying bedrock (i.e. clayey tills overlie slates of the Gander Lake Group, whereas sandy or gravelly tills overlie the rocks of the Musgravetown Group).

Part of the end moraine which separates the inner and outer drift zones in eastern Newfoundland lies within the Bonavista Bay area. From the study boundary on the south side of Gander Lake, it stretches in a southeasterly direction and exits the study area south of Clode Sound. While this deposit is one of the most important in the region (due to its usefulness in the interpretation of regional glacial history), it is generally inconspicuous on the ground. It can be recognized either where glacial outwash deposits describe a radial pattern or through the presence of small boulder strewn hills and hillocks. In many instances, granitic rocks lie immediately to the west of these hillocks, thus explaining the coarse nature of the material. Where the internal composition of the end moraine is exposed, granitic boulders - as much as 6 m (20 ft) in diameter - are seen piled in small hillocks combined with finer size material, all unsorted and unstratified.

3.1.2 Esker and Kame Deposits:

Several eskers have been identified within the study area and all are found inland, immediately west of the end moraine previously mentioned. These eskers, generally found near areas of granitic bedrock, are parallel to the direction of regional ice movement.

Jenness (1963) documented the presence of a small, 8 m (26 ft) high kame, exposed in a railway cut approximately 1.6 km (1 mi) north of Terra Nova. Probable kame terraces exist in at least two locations within the study area, one south of Gander Lake and the other just west of Gambo. The composition of the former, which lies approximately 122 m (400 ft) above sea level, can be described as mainly gravel; the coarse fraction ranges from pebbles near the base, to boulders near the top. The latter kame terrace lies approximately 46 m (150 ft) above sea level and consists of well sorted and stratified sands and gravels.

3.1.3 Outwash Sand and Gravel Deposits:

Several significant outwash sand and gravel deposits occur in valleys leading from interior portions of the study area to the sea. Principal among these are the following deposits:

1) Sands and gravels are found in the valley leading from the southeast end of Gander Lake to Freshwater Bay. They mainly consist of fine to coarse, well stratified sands and in places are more than 15 m (49 ft) thick.

2) Well stratified and cross-bedded sands lie within

the stream channel of Northwest Brook and two small streams flowing into Gambo Pond.

3) Deposits of sand, gravel and clay occur along the valley of the Terra Nova River and are most evident approximately 13 km (8 mi) above the river mouth at an approximate elevation of 36.6 m (120 ft), where they form a terrace.

4) Deposits occur in the Northeast Arm (Alexander Bay) - Eastport areas. Deposits are exposed along a highway cut west of Northeast Arm and within a small pit approximately 0.8 km (0.5 mi) west of the mouth of Northeast Arm. These deposits range in grain size from pebbly sands to well stratified sands and gravels, with lenses of pebbles and fine sands. A well stratified cross-bedded fine sand deposit, overlain by coarse sands and small boulders, is exposed east of Sandringham, 6.4 km (4 mi) east of Northeast Arm.

5) Several other strongly dissected sand and gravel outwash deposits occur within the study area including:
   a) along the valley west of Glovertown;
   b) within the Saltons Brook valley which leads

to the northwest corner of Newman Sound;

c) along Big Brook leading into the southwest corner of Newman Sound;

d) near Port Blandford in Clode Sound;

e) along Southwest Brook;

f) within the valley leading into Smith Sound at Georges Brook;

g) within the valley leading into Bonavista Bay at Plate Cove.

3.1.4 Deltaic Deposits:

Deltaic deposits occurring at the seaward ends of four outwash valley trains in Eastport, Sandy Cove, Middle Brook and Port Blandford were identified by Jenness (1963). Typically they consist of thinly bedded sand, silt and clay units and in some cases, the uppermost sequence includes a coarser pebble unit. Other deltaic deposits within the study area are located at Traytown, Northwest Arm of Alexander Bay and Plate Cove.

3.2 Bedrock Geology

The Bonavista Bay area is underlain by rocks belonging to three distinctive tectono-stratigraphic zones of the Newfoundland Appalachians, namely the Avalon, Gander and Dunnage Zones. Each is characterized by unique sequences of sedimentary and volcanic rocks and by unique deformation styles, and they are separated from one another by major structural breaks. The three zones are considered here in the context of their plate tectonic history - that is in relation to the creation and subsequent destruction of a "proto-Atlantic" ocean in central Newfoundland during Paleozoic times.

The most easterly terrain is the Avalon Zone (see Map No. 1 - units 2, 3 and 5-8). Sedimentary and volcanic rocks of the Avalon Zone range in age from Late Precambrian to Upper Cambrian. They are scarcely metamorphosed and are realtively undeformed compared to rocks to the west, having been folded by open to locally tight northeast trending anticlines and synclines. At the base of the sequence, the Love Cove Group consists of predominantly subaerial volcanic rocks and is overlain by an upper assemblage of Precambrian sedimentary and minor volcanic rocks in which sandstone predominates (Connecting Point and Musgravetown Groups - units 3 and 5 respectively). An intermediate assemblage of marine siliceous slates and greywackes (Conception Group) is widely present in the Avalon Zone but does not occur in the study area. A Cambrian sedimentary sequence (Random Formation, Adeyton Group and Harcourt Group - units 6, 7 and 8 respectively) overlies these Precambrian rocks and represents a time when the Zone was a stable platform or marine shelf. The regional tectonic significance of the Avalon Zone is not yet fully understood. During Precambrian times the Zone is thought to have been either a rift belt relating to the opening of the Iapetus (proto-Atlantic) ocean or to a subduction event that preceded the opening of the Iapetus. Correlatives of the Avalon Zone rocks have been described on the other side of the present-day Atlantic Ocean in western Europe and north Africa. The Avalon Zone is bounded on the west by the Dover Fault, a 300 - 500 m (984 - 1,640 ft) wide mylonite zone which separates the Avalon from the Gander Zone.

The Gander Zone (see Map No. 1 - units 1 and 9) comprises the eastern margin of the Iapetus ocean. The basal Bonavista Bay Gneiss Complex (Unit 1) consists of intensely deformed and recrystallized sedimentary and plutonic rocks, and is generally thought to be Precambrian in age. It is overlain in the west by the Gander Group (Unit 9) of polydeformed metasedimentary rocks which are interpreted as comprising a sedimentary prism built up parallel to an existing shoreline of the Iapetus ocean. Deformation of these rocks is thought to have begun in

Early Ordovician times, and is characterized by southeast facing recumbent folds which may relate to ophiolite obduction along the Gander-Dunnage Zone boundary. That boundary is a major fault.

The Dunnage Zone (see Map No. 1 - units 10 - 15) represents vestiges of an ocean domain, and this is particularly evident in the presence of the Gander River Ultramafic Belt (unit 10) - interpreted as being part of an ophiolite suite - along its eastern boundary. Marine sequences of the Ordovician Davidsville Group (units 11 and 12) include the "Dunnage Melange", a chaotic terrane commonly interpreted as marking the site of an oceanic trench or subduction zone. Rocks of the Davidsville Group are foliated and polydeformed, but the structures are not as complex as those of the Gander Zone rocks. Still less deformed are the overlying clastic sedimentary rocks and volcanic rocks of the Silurian Indian Islands and Botwood Groups. Shearing is widespread in the Indian Islands Group (unit 13); and no direct correlation is possible with the Botwood Group (units 14 and 15), which itself is only slightly metamorphosed.

Rocks of the three tectono-stratigraphic zones have been intruded by a variety of basic to acidic plutonic rocks (see Map No. 1 - units 4, 16 - 18). The oldest of these rocks (unit 4) are thought to be Precambrian in age and consist of foliated quartz-bearing plutons which include the Dover Fault Granite and Lockers Bay Granite. The occurrence of these intrusive rocks is restricted to the Gander Zone. Intrusive rocks of Devonian age or earlier (units 16 and 17) include intermediate to basic plutons on Fogo Island and on a few small islands in Bonavista Bay. Foliated to massive granites characterized by widespread garnetiferous phases occur in all three tectono-stratigraphic zones. Quartz monzonite and quartz diorite assigned to this group of plutons occur in the Rocky Bay area. Included in this broad assemblage of Devonian intrusive rocks is a large number of separate plutons which have been named on more detailed maps. These are the Cape Freels Granite, Business Cove Granite, North Pond Granite and Wareham Granite; and (in the Rocky Bay area) the Ragged Harbour Pluton, Frederickton Pluton, Aspen Cove Pluton and White Point Pluton. The youngest intrusive rocks (unit 18) in the area are now generally considered to be Carboniferous in age and consist of massive medium to coarse-grained and megacrystic biotite granites which include the Deadman's Bay Granite, Newport Granite and Big Round Point Granite.

4 HYDROGEOLOGY

4.1 Introduction

4.1.1 Data Availability:

The hydrogeological assessment and characterization of the Bonavista Bay area relied largely upon the available drilled well records. The Department of Environment, Water Resources Report 1-1 Groundwater Series (1979) was invaluable in working with the existing drilled well data. Recent drilled well records for the study area, provided by the Water Resources Branch (through the co-operation of local drillers), were used to update the existing records. Appendices A and B contain a complete listing, according to location, of all the compiled drilled well records in the surficial and bedrock materials respectively.

Until now, the keeping and submission of the drilled well records was based entirely upon the goodwill of the provincial well drillers and not provincial regulation. Thus considerable variation in the content and quality control of the available records exists. However, the recent enactment of the Well Drilling Act by the provincial legislature will improve this situation.

Generally, as the records currently exist, the only hydrogeologic data consistantly available from the well records is the estimated well yield and depth. Consequently, analysis of the well records centers on these two parameters. It must be stressed that the estimated yield information available on the drilled well records, does not necessarily represent the short or long term safe yield of the well. To accurately determine such values, step-drawdown and aquifer pumping tests must be conducted. These tests are often required (or should be) to assure the long term ground water availability for municipal or industrial wells. Nevertheless, a relative comparison of the ground water potential in the geologic units throughout the study area is possible based on the estimated yields obtained from the drillers' records.

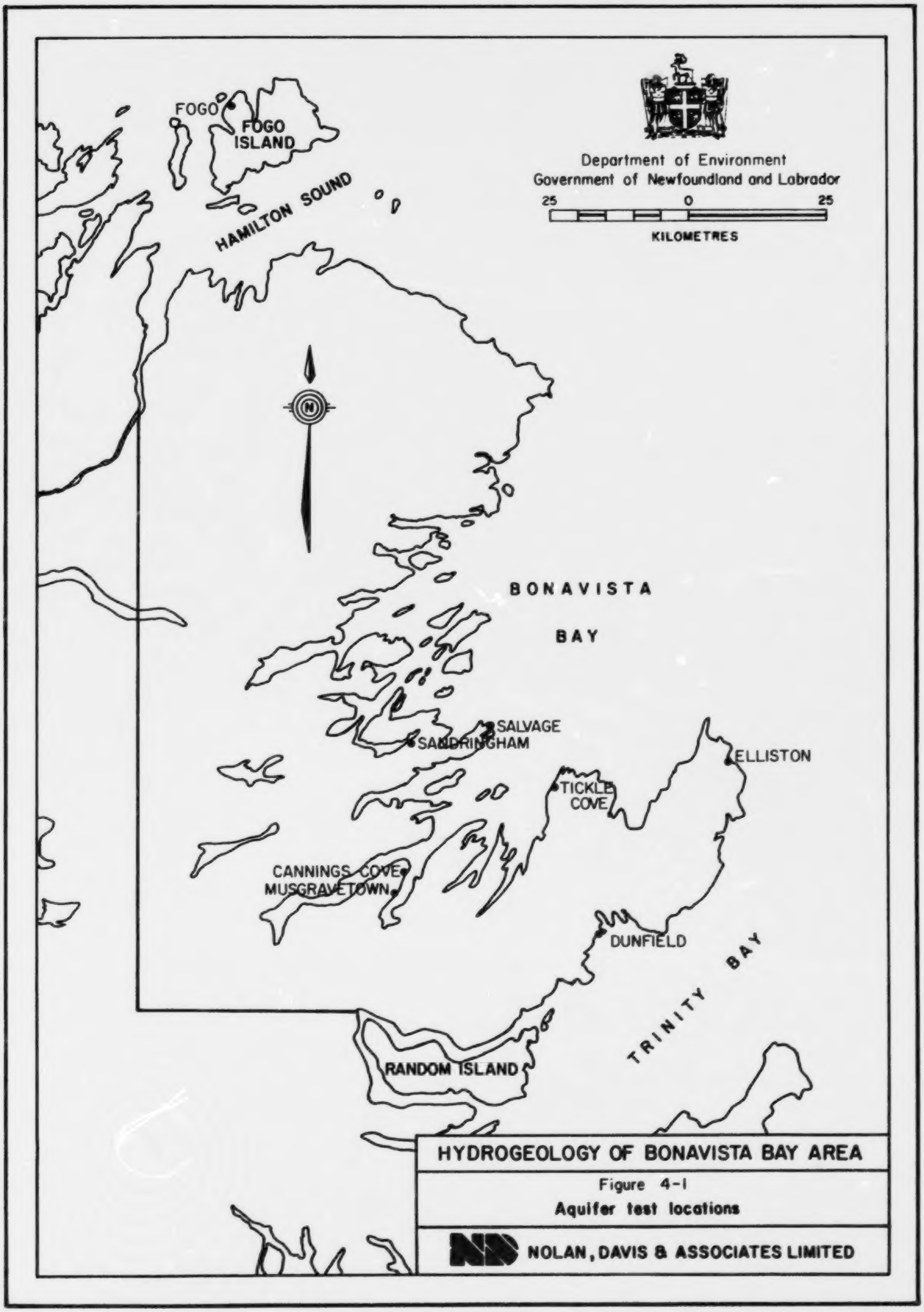
Apart from the drilled well records, little information of a hydrogeologic nature was available for the study area, the report on the Terra Nova Regional Waste Disposal Site provided an exception. The report for the Atlantic Development Board by Shawinigan and MacLaren (1968) was quite general and somewhat outdated. Although this and similar studies were not field oriented, the considerable expertise and familiarity developed by Nolan, Davis & Associates within the Bonavista Bay area was able to complement existing published data. In addition to the results of ten aquifer tests conducted by the firm within the study area (see Figure 4-1 and Table 4-1), various other site/problem specific hydrogeologically related investigations provided useful and pertinent background information for this study. This information enabled better characterization of the hydrostratigraphic units within the Bonavista Bay area.

4.1.2 Well Distribution:

Primarily because of the economic and historical importance of the sea, most population centers within the study area are located along the coast as Chapter One, Section 1.3 indicates. Thus most drilled wells are situated along the coast. This has produced an irregular distribution of wells within the study area both on a geographical and geological basis.

Considering all the 549 drilled bedrock wells in Appendix B, the number and percentage of wells and their geological distribution is as follows:

ROCK TYPE	NO. OF WELLS	PERCENT OF TOTAL
granitic	347	63.2%
mafic intrusions	84	15.3%


Department of Environment
Government of Newfoundland and Labrador
25
0
25
KILOMETRES
N
FOGO
FOGO ISLAND
HAMILTON SOUND
BONAVISTA BAY
SALVAGE
SANDRINGHAM
ELLISTON
TICKLE COVE
CANNINGS COVE
MUSGRAVETOWN
DUNFIELD
TRINITY BAY
RANDOM ISLAND

HYDROGEOLOGY OF BONAVISTA BAY AREA

Figure 4-1

Aquifer test locations

NOLAN, DAVIS & ASSOCIATES LIMITED

TABLE 4-1

AQUIFER TEST DATA

LOCATION	GEOLOGICAL UNIT	PUMPING RATE (lpm)	DURATION (HOURS)		SAFE YIELD (lpm)
			PUMPING	RECOVERY	
Cannings Cove	Musgravetown Group	73	21	3	68
Dunfield No. 1	Musgravetown Group	28	24	2	23
Dunfield No. 2	Musgravetown Group	41/34	8.5/12.5	1.5	9
Dunfield No. 3	Musgravetown Group	23/14	2/0.5	-	7
Elliston	Musgravetown Group	14	20	1.5	7
Fogo	Botwood (Sed.) Group	68	25	2	68
Musgravetown No. 1*	Musgravetown Group	32/73	3.1	-	-
Musgravetown No. 2	Musgravetown Group	36	23	7	18-23
Musgravetown No. 3	Musgravetown Group	23	24	7	18-23
Salvage	Connecting Point Group	91	70	2	55-68
Sandringham No. 1	Connecting Point Group	91	12	1	na
Sandringham No. 2	Connecting Point Group	136	36	3	na
Tickle Cove	Musgravetown Group	23	20	1.5	23

* - Preliminary test to determine longer term pumping rate

na - not yet available

metamorphic	44	8.0%
sedimentary	39	7.1%
meta-sedimentary	14	2.6%
volcanic	17	3.1%
meta-volcanic	1	.2%

As a consequence of the bias toward well distribution along the coast and the remoteness of some geologic units within the study area, little or no drilled well information is available for some geologic units. The units effected are:

GEOLOGIC UNIT	NAME
1	Bonavista Bay Gneiss Complex
4	Hadrynian (?) igneous rocks
6	Random Formation
7	Adeyton Group
8	Harcourt Group
9	Gander Group
10	Gander River Ultramafic Belt
13	Indian Islands Group
14	Botwood Group (volcanic member)

No information is available on either the total number of shallow dug wells or their distribution. Certainly one would expect the distribution to parallel the population centers, thus most dug wells are likely located along the coast.

In the Bonavista Bay area there are very few drilled wells in the surficial materials. Typically such wells have no screens but depend upon ground water entering the bottom area of the well or from a zone one or two feet thick which is uncased (see Appendix A). Carmanville, Terra Nova, Port Blandford and Sandringham are the only locations where attempts have been made to utilize drilled wells in the surficial materials. The use of screens was only attempted in two known instances and in neither case were they used successfully. Generally, well drilling and screen selection and installation is done without proper supervision. Consequently the ground water producing zones are not properly identified and screens are not sized properly and/or installed correctly within these producing zone(s).

4.1.3 Well statistics:

As previously indicated, a total of 549 drilled bedrock wells have been compiled for the study area. These wells are located by community and numbered consecutively on the bedrock hydrogeologic maps (i.e. Maps No. 2 and 3 respectively). Unfortunately only 390 wells could be utilized statistically as only those wells having both yield and depth information could be used in discussing the hydrostratigraphic units. Within the various geologic units no correlation exists between well yield and depth.

Drilled well information is only available for 10 surficial wells. These are listed in Appendix A according to location and numbered consecutively.

Based on a knowledge of the Bonavista Bay area, it is known that the number of dug wells is substantially greater than the number of drilled wells. An estimate of the number of dug wells in the study area would certainly be in the range of several thousand. Unfortunately, this is a number that is impossible to better quantify.

4.2 Hydrostratigraphic Units

The concept of a hydrostratigraphic unit was developed to enable classification of geologic units for hydrogeologic purposes. Thus a hydrostratigraphic classification refers to the water-bearing potential of a particular geologic unit. This permits hydrogeologic grouping of geologically-distinct units based primarily on their ability to yield and/or transmit ground water.

Unfortunately for several bedrock units little or no hydrogeologic information was available, as has been previously indicated, consequently no hydrostratigraphic classification was attempted for those particular bedrock units. However; based on the lithological nature of the non-classified geologic units; there is no reason to believe that their yields would differ substantially from those units which were used in developing the hydrostratigraphic units.

The use of hydrostratigraphic units can be applied both to surficial and bedrock materials. For the surficial aquifers, little or no existing information was available for most of the study area as has been indicated. Consequently the hydrostratigraphic units used for the surficial materials were developed based on their potential yields as opposed to actual estimated yields.

4.2.1 Surficial Aquifers:

Only two surficial hydrostratigraphic units have been characterized within the Bonavista Bay area. This results from the lack of well (dug or drilled) information in the surficial materials and the limited variety and mapping of glacial deposits. Development of additional hydrostratigraphic units for kames, kame terraces or eskers and deltaic sediments was not considered justified. These deposits are either so poorly defined or so small that development of additional hydrostratigraphic units would not be considered meaningful. The esker, kame, kame terrace and deltaic deposits are briefly discussed within Surficial Hydrostratigraphic Unit - S2 and are considered as part of this unit until additional information suggests otherwise.

4.2.1.1 Surficial Hydrostratigraphic Unit - S1

This unit is composed of the most prevelant and widespread surficial deposit occurring within the Bonavista Bay study area - moraine composed of glacial till. Many (if not most) domestic water supplies inside the study area are derived from dug wells constructed within this unit. Most of these wells are probably poor producers with average yields estimated to be less than 9 lpm (2 gpm); the users probably depend heavily upon the storage of the well.

Geological and geotechnical studies conducted in the study area indicate the particle size distribution of the till varies but can typically be described as a very poorly sorted silty sand and gravel, often reflecting the nature of the underlying bedrock. The well graded nature of the material, together with the relatively high silt and clay content, accounts for the low to very low permeability of the till. Estimates of permeability range from 10^{-5} to 10^{-8} cm/sec based on field observations and sieve analyses.

Work conducted by Nolan, Davis & Associates at several locations within the Bonavista Bay area clearly point out the multiple problems inherent in attempting to develop wells for water supply purposes in the local tills. In many instances, blasting is required to increase the depth of the well when bedrock is encountered during construction. The freezing of or frost damage to pumping equipment and water supply lines is a common problem in the winter due to insufficient soil cover. Similarly, water supplies from many dug wells are undependable during the summer months when water table elevations drop below the penetration depth of the well. Where till thickness allows adequate penetration, few problems are encountered in reaching the water table with dug wells.

4.2.1.2 Surficial Hydrostratigraphic Unit - S2

Glaciofluvial deposits, primarily outwash sands and gravels, form this hydrostratigraphic unit. While not overly abundant in the Bonavista Bay study area, glaciofluvial deposits offer far greater potential for ground water resource development than does the S1 unit previously discussed. Although limited data exists, it indicates a number of wells have been successfully constructed in glacial outwash deposits. These deposits occur mainly in valleys leading from inland areas to the sea and have been previously described as well stratified sands, to pebbly sands to stratified sands and gravels. Limited data on both the lithology and ground water potential of these deposits is available but is inconclusive since little field work has been conducted and because a large percentage of the deposits are removed from populated areas.

Drilled well records compiled in Appendix A indicate at least 9 wells have been constructed in the community of Terra Nova, presumably within the sand and gravel outwash deposit which lies in the Terra Nova River Valley. With one exception, all of the wells are utilized for domestic water supply. The wells penetrate 7.6 to 20.7 m (25 to 68 ft) of overburden which is described, in the well records, as being mainly sand or sand and gravel, with some boulders. Only 4 of these wells have static water level data; these measurements range from a depth of

3 to 6.1 m (10 to 20 ft). Estimated yields for the wells range between 56 and 181 lpm (12.3 and 40 gpm). In the community of Carmanville, one well was drilled a total of 7.9 m (26 ft) into overburden; it is probable that the well is located in the sand and gravel outwash deposit underlying the community. The estimated yield of this well is 273 lpm (60 gpm). The construction features of these wells are elsewhere discussed.

Additional information on the outwash sands and gravels in the Terra Nova area is presented in the provincial Department of Environment internal report "Terra Nova Regional Waste Disposal Site" (Robinson and Lethbridge, 1979). The overburden is described as consisting of a homogenous gravelly silty sand with very little stratification and within the site ranged in thickness from 5.2 to 7.3 m (17 to 24 ft). Based on grain size analyses performed on samples recovered during piezometer installation, a permeability of approximately 10^{-4} cm/sec was estimated. This was supported by permeability values of 1.5 to 9.9 x 10^{-3} cm/sec obtained from slug testing of the piezometers.

Several eskers have been identified in the Bonavista Bay region and all appear to be found inland. They are typically comprised of well sorted sands of relatively high permeability but because of their configuration the eskers are most often found to be well drained and subsequently have a minimal saturated thickness.

Deltaic deposits occur at the seaward terminus of several outwash valley trains throughout the study area as previously discussed. No information is available on the saturated thickness or areal extent of the sands and gravel units within these deltaic deposits. Jenness (1963) does note ground water seepage zones in several locations where clay units underlie coarser sand deposits. These deposits offer some potential as aquifers but their development may be hampered by insufficient saturated thickness or difficulty in identifying and developing prospective water bearing zones.

4.2.2 Bedrock Aquifers:

4.2.2.1 Hydrostratigraphic Unit 1

The meta-volcanic and sedimentary rocks of the Love Cove, Adeyton and Harcourt Groups comprise this hydrostratigraphic unit. The ground water yielding potential of this unit is poor. Consequently wells drilled in this unit should be considered only marginally useful in meeting domestic needs.

Although 24 wells have been drilled within the geologic members of this hydrostratigraphic unit, well yield and depth information is available for only 12 wells. Using the currently available data pairs (i.e. yield and depth information for the same wells) the mean yield is 5 lpm - litres per minute (1.1 gpm - gallons per minute) with a range of 1.1 to 22.7 lpm (.25 to 5 gpm). The mean well depth is approximately 49.7 m (163 ft) with a range of 16.8 to 99.1 m (55 to 325 ft). None of the wells within this unit have yields in excess of 45 lpm (10 gpm), while 75% have yields between 0 and 4.5 lpm (0-1 gpm). Table 4-2 summarizes the data for this hydrostratigraphic unit and the constituent geologic units.

The above information on ground water yield and well depth is based on very limited data - this must be stressed. The information from two wells (Appendix B - No. 66 and 68) were not included in the well statistics. The uncharacteristically high yields from these wells presents too much of a bias in the mean yield if included, consequently they were omitted. The implications presented by these high yields is discussed later.

TABLE 4-2

BEDROCK WELL STATISTICS

HYDROSTRATIGRAPHIC UNIT	GEOLOGICAL UNIT	NO. OF WELLS	YIELD (lpm)				DEPTH (M)			
			MEAN VALUE	RANGE	NO. & % OF WELLS YIELDING 0 - 4.5	NO. & % OF WELLS YIELDING > 45	MEAN VALUE	RANGE	NO. & % OF WELLS BOTTOMING 0 - 30	NO. & % OF WELLS BOTTOMING > 61
1	2, 7 & 8	12	5	1.1-22.7	9/75%	0/0%	49.7	16.8-99.1	5/42	1/8
	2	10	5.5	1.1-22.7	7/70%		46.7	16.8-61.0	4/40	-
	7	1	2.3		1/100%				-	1/100
	8	1	2.3		1/100%				1/100	-
2	3 & 12	69	10.5	0-56.8	27/39.1%	2/2.9%	48.4	12.8-115.8	14/20	16/23
	3	55	10.0	1.1-45.5	22/40%	1/1.8%	50.3	12.8-91.4	9/16	14/26
	12	14	12.7	0-56.8	5/35.7%	1/7.1%	41.2	25.9-115.8	5/36	2/14
3	11 & 15	69	18.2	0-159.1	26/37.7%	7/10.1%	44.5	9.1-116.7	25/36	16/23
	11	34	18.2	1.1-159.1	17/48.6%	3/8.6%	40.4	13.7-98.5	17/50	6/18
	15	35	18.2	0-104.6	9/26.5%	4/11.8%	48.6	9.1-116.7	8/23	10/29
4	16, 17 & 18	38	26.4	6.8-68.2	1/2.6%	5/13.2%	60.4	16.5-135.0	4/10.5	17/45
	16	9	25.9	11.4-50.0	0/0%	1/11.1%	47.7	16.5-80.2	2/22	3/33
	17 18	29	26.8	6.8-68.2	1/3.4%	4/13.8%	66.4	22.6-135.0	2/7	14/48
5	5	202	28.6	0-409	47/23.3%	28/13.9%	44.7	9.1-152.4	72/36	40/20
TOTAL		390								

Although currently available information indicates poor ground water potential within Hydrostratigraphic Unit 1, much more hydrogeologic information will be required on all the forementioned geologic units before this conclusion can be supported statistically.

Hydrostratigraphic Unit 1 is not found in the northern half of the study area above Freshwater Bay and Lockers Bay. The Love Cove Group comprises most of this hydrostratigraphic unit (see Map No. 3).

4.2.2.2 Hydrostratigraphic Unit 2

This generally low-yielding unit consists of meta-sedimentary and sedimentary rocks from the Connecting Point and Davidsville (sedimentary member) Groups. Hydrostratigraphic Unit 2 is capable of producing minimally adequate ground water yields only for domestic needs. The Connecting Point and Davidsville Groups consist of sedimentary rock types with intrinsically low primary permeability. These geologic units may offer less potential for development of secondary permeability because of their ability to undergo small plastic deformations when subjected to low strength tectonic forces.

Based on a total of 69 drilled wells, the mean yield for this unit is 10.5 lpm (2.3 gpm) with a range of 0 to 56.8 lpm (0 to 12.5 gpm). The mean well depth for Hydrostratigraphic Unit 2 is 48.4 m (158.9 ft) with a range of 12.8 to 115.8 m (42 to 380 ft). The mean yield for the Davidsville and Connecting Point Groups are 12.7 and 10.0 lpm (2.8 and 2.2 gpm) respectively. The mean well depth in the Davidsville Group is approximately 41.2 m (135.3 ft) while 50.3 m (164.9 ft) is the mean value in the Connecting Point Group (see Table 4-2). 39.1% of the wells within Hydrostratigraphic Unit 2 have yields between 0 - 4.5 lpm (0 - 1 gpm) and 2.9% have yields greater than 45 lpm (10 gpm).

Hydrostratigraphic Unit 2 is most prevelent in the southern portion of the study area - north of Random Island and in the vicinity of Chandler Reach; and in the northern portion of the study area - south of Hamilton Sound (see Map No. 3). While the Connecting Point Group occurs only in the southern portion, it comprises most of this hydrostratigraphic unit.

4.2.2.3 Hydrostratigraphic Unit 3

In terms of the potential for meeting domestic supply requirements Hydrostratigraphic Unit 3 must be considered good. The existing yields also offer some potential for meeting low demanding industrial or municipal applications.

Data from 69 drilled wells indicates the mean yield for this unit is 18.2 lpm (4 gpm) with a range of 0 to 159.1 lpm (0 - 35 gpm). The mean well depth is 44.5 m (145.9 ft) with a range of 9.1 to 116.7 m (30 to 383 ft). Within this unit 37.7% of the wells have yields between 0 and 4.5 lpm (0 - 1 gpm) while 10.1% have yields greater than 45 lpm (10 gpm). The mean yield in both the Botwood and Davidsville Groups is the same, however the range in yields is greater for the Davidsville Group. The water bearing potential of these groups is influenced by both primary and secondary permeability. Both groups could potentially have significant primary permeability but in the case of the volcanic Davidsville Group it's likely that any available voids will not be interconnected thus eliminating any water potential due to primary permeability (see Table 4-2).

This hydrostratigraphic unit is found exclusively in the northwestern corner of the Bonavista Bay area. The volcanic Davidsville Group is found south of Hamilton Sound while the sedimentary Botwood Group is found only on Fogo and Change Islands.

4.2.2.4 Hydrostratigraphic Unit 4

Intrusive granitic and mafic rocks comprise this fourth hydrostratigraphic unit. This unit appears to offer good yield potential for domestic wells. The available yields within this unit will restrict utilization of ground water to the lesser demanding municipal and industrial applications. With proper expertise in developing a ground water supply, this unit could satisfy limited municipal and industrial applications.

The consistently high (relative to the other rock types in the study area) reported yields is generally surprising, especially if the low or practically non-existent primary permeability of these rocks is considered. The relatively substantial yields reported, principally from the granitic rocks, must be attributable to secondary permeability. This indicates development of considerable jointing and fracturing within these rock masses throughout the study area.

For Hydrostratigraphic Unit 4 the mean yield is 26.4 lpm (5.8 gpm) with a range of 6.8 to 68.2 lpm

(1.5 to 15 gpm) based on 38 drilled wells. It is surprising that only 2.6% of the wells have 0 - 4.5 lpm (0 - 1 gpm) yields while 13.2% have yields in excess of 45 lpm (10 gpm). Although the range in estimated well yields is small, this unit has the lowest percentage of wells with yields between 0 and 4.5 lpm and the highest percentage with yields greater than 45 lpm. While the results are based on fewer wells than have been drilled in other hydrostratigraphic units, they are certainly indicative of continued good potential yields. The mean depth for this unit is 60.4 m (198.3 ft) with a range of 16.5 to 135.0 m (54 to 443 ft). It is also noteworthy that the well depths are substantially deeper than wells in other units, this is especially true for the granites (see Table 4-2).

This hydrostratigraphic unit is comprised principally of granitic rocks and is located in the central and northern portions of the study area (see Map No. 3). Infact the mafic intrusives are only found on Fogo Island (see Map No. 1).

4.2.2.5 Hydrostratigraphic Unit 5

This unit offers good potential yields and has produced the largest reported bedrock yields - 409 lpm

(90 gpm), within the study area. Hydrostratigraphic Unit 5 offers excellent potential for meeting domestic requirements for ground water. Potential for meeting larger municipal or industrial ground water requirements may be possible. Proper siting and supervision of drilled wells, to take advantage of local topography, potential infiltration systems, fracture lineations and encountered production zones, will be required to maximize potential yields in this unit for large scale municipal and industrial ground water needs. Musgravetown Group, which consists of sedimentary rocks, comprises this hydrostratigraphic unit. The pebble conglomerate and sandstone composition of the Musgravetown Group has potentially good primary permeability which has probably been enhanced by development of secondary permeability as a result of structural deformation within the Musgravetown Group (see Map No. 1).

For Hydrostratigraphic Unit 5 the mean yield, based on 202 wells, is 28.6 lpm (6.3 gpm); the range is 0 to 409 lpm (0 to 90 gpm). This mean yield value is supported by the results of eight short term aquifer tests within the Musgravetown Group. The average reported long term safe yield of 22.2 lpm (4.9 gpm), though obviously less than the mean yield based on estimated drillers' estimates, provides reasonable agreement when the range in accuracy of the two methods is considered. The mean well depth is 44.7 m (146.7 ft) with a range of 9.1 to 152.4 m (30 to 500 ft). Within this unit 23.3% of the wells drilled have a yield between 0 - 4.5 lpm (0 - 1 gpm) while 13.9% have yields in excess of 45 lpm (10 gpm). Table 4-2 summarizes these results. The aquifer potential of the Musgravetown Group is indicated by the number of wells that have been drilled within this group. Infact more wells have been drilled in this hydrostratigraphic unit than all others combined.

This unit predominates in the Bonavista Bay Peninsula area and the south central portion of the study area as Map No. 3 indicates.

4.3 Ground Water Flow Systems

Most bedrock and surficial aquifers within the study area can be considered as unconfined and although truely confined aquifers certainly do exist, they are probably the exception rather than the rule (based on the firm's experience, the Driller's records and the predominance of fracture flow). Consequently, the water table surface rather than the potentiometric surface, will define the upper boundary of the saturated zone from which available ground water can be obtained.

The water table surface will fluctuate seasonally. Generally it rises in the spring and fall in response to recharge events such as snow melt and/or precipitation. During the winter and summer it drops due to 1) lack of recharge; 2) continued natural discharges of ground water into surface water bodies; or 3) evapotranspiration. Seasonal fluctuations within the study area may vary widely. They will generally, though not necessarily, be greater within bedrock aquifers than surficial aquifers (thus normally productive dug wells may become dry in the summer). Variation in seasonal fluctuations can be expected throughout the study area in response to local conditions but changes of .5 to 1.5 m (1.6 to 4.8 ft) and 1.5 to 3 m (4.8 to 9.8 ft) for surficial and bedrock aquifers could be considered representative based on the firm's experience.

The water table surface will model the overlying and surrounding topography but will reflect it more subtley (Toth, 1963). Ground water flow will be in response to the differences in total hydraulic head between any two points; in turn the hydraulic head will be governed by changes in the elevation head and pressure head. The concepts of ground water flow within small basins (maximum 1000 km^2 in area), as characterized by Toth (1963) are particularly well suited for studying the ground water flow regimes within the Bonavista Bay study area due to the typically small sized basins. Both the variability of the relief and the dissection of the study area by surface water bodies (including coastal inlets) will promote development of local ground water flow systems throughout the coastal and southern portions of the study area. As defined by Toth (1963), "A local system of ground water flow has its recharge area at a topographic high and its discharge area at a topographic low that are located adjacent to each other". While larger scale intermediate flow systems may be present within the study area, its influence on ground water flow within the population centers is probably small. Consequently the physical and chemical characteristics of the ground water utilized in most coastal and many inland areas will be controlled by local conditions. Thus even within the same geologic unit, variations in ground water characteristics can be expected throughout the study area. Intermediate flow systems; in which the ground water recharge and discharge areas are not necessarily located in either the highest or lowest areas respectively; are probably of more importance within the western portion of the study area.

Ground water flow from these local systems throughout the study area will be directed toward the sea coast or adjacent inlet. Further inland, near the western boundary of the study area this local flow will be directed toward rivers, streams or lakes between areas of local topographic relief.

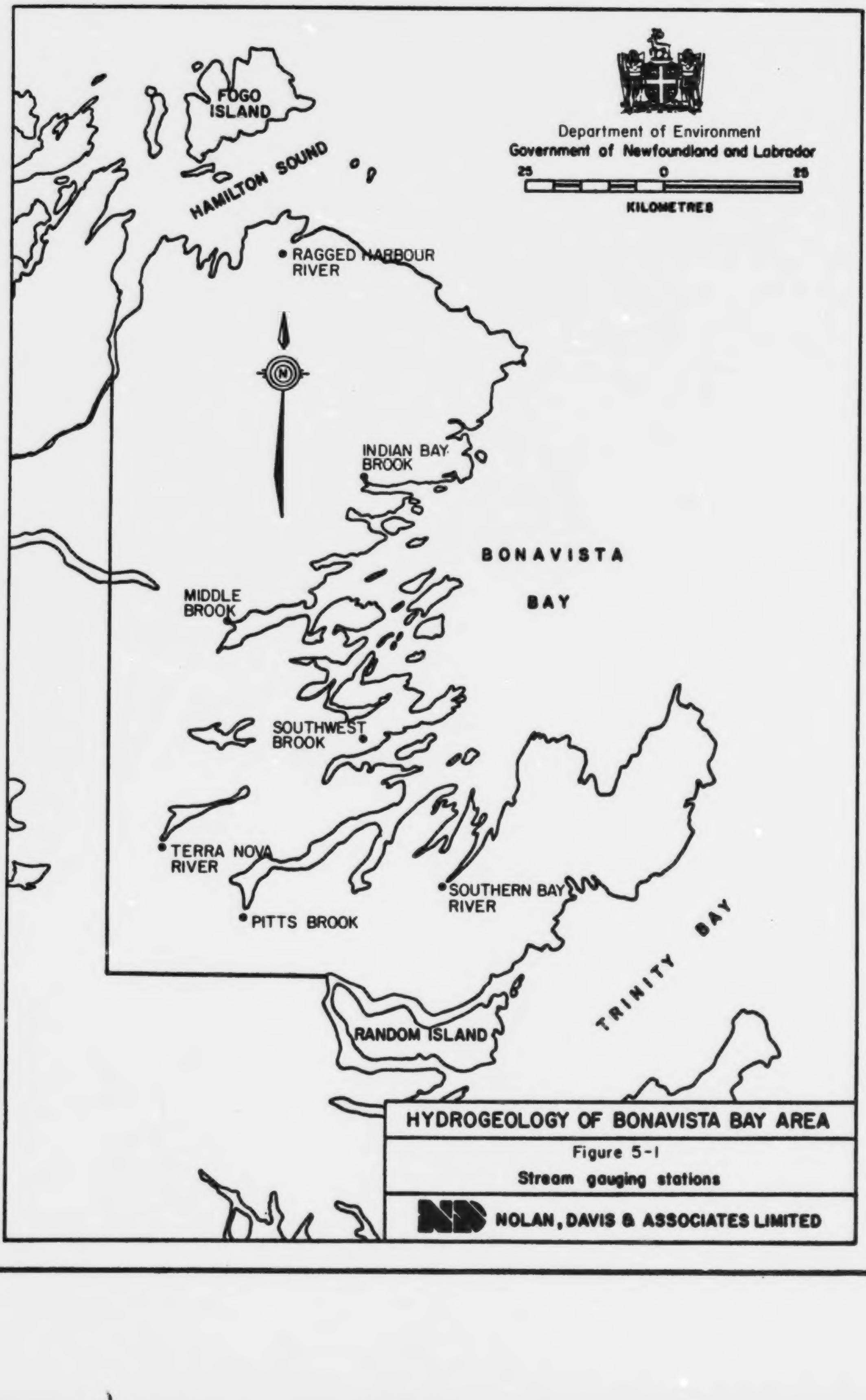
5 HYDROLOGY

5.1 Introduction

In order to more accurately determine the regional physical characteristics of the major geologic units, in relation to the quantity and availability of ground water, physical hydrological data was utilized to delineate the rate of ground water recharge and its availability for pumping from surface water intake structures.

Streamflow within the study area is moniotred by Environment Canada - Water Survey of Canada at seven sites (see Figure 5-1). Table 5-1 lists the relevant information.

Due to the unavailable errors in streamflow measurement, i.e. under ice conditions and during very low summer flows; coupled with the inaccuracies inherent in the available statistical methods used to determine the


FOGO ISLAND
HAMILTON SOUND
Department of Environment
Government of Newfoundland and Labrador
25
0
25
KILOMETRES
RAGGED HARBOUR RIVER
N
INDIAN BAY BROOK
BONAVISTA BAY
MIDDLE BROOK
SOUTHWEST BROOK
TERRA NOVA RIVER
PITTS BROOK
SOUTHERN BAY RIVER
TRINITY BAY
RANDOM ISLAND

HYDROGEOLOGY OF BONAVISTA BAY AREA

Figure 5-1

Stream gauging stations

NOLAN, DAVIS & ASSOCIATES LIMITED

TABLE 5-1

HYDROMETRIC STATION DATA
(as of September 1981)

Station Name & Number	Location	Drainage	Type of Flow	Period of Record	Type of Gauge
1. Terra Nova River at Eight Mile Bridges #02YS001	Lat 48°26'30" Long 54°22'21"	1,290km^2	Natural; note seasonal regulation for log driving prior to 1963	February 1951 to present	Automatic
2. Ragged Habour River near Musgrave Harbour #02YR002	Lat 49°23'35" Long 54°06'25"	399km^2	Natural flow	June 1977 to present	Automatic
3. Indian Bay Brook near Northwest Arm #02YR003	Lat 49°92'24" Long 53°53'00"	344km^2	Natural flow	Fall 1980 to present	Automatic
4. Middle Brook near Gambo #02YR001	Lat 48°48'28" Long 54°13'28"	267km^2	Natural flow	February 1959 to present	Automatic
5. Southern Bay River near Southern Bay #02ZJ001	Lat 48°22'49" Long 53°40'36"	67.4km^2	Natural flow	May 1976 to present	Automatic
6. Southwest Brook at Terra Nova National Park #02YS003	Lat 48°36'25" Long 53°58'50"	39.2km^2	Natural flow	November 1967 to present	Automatic
7. Pitts Brook near Port Blandford #02YS004	Lat 48°18'55" Long 54°10'45"	10.8km^2	Natural Flow	August 1975 to September 1975 inclusive	Automatic

ground water component of streamflow, only two stations were felt to have a long enough period of record. These stations are the Terra Nova River at Eight Mile Bridges, #02YS001 and #02YR001, Middle Brook near Gambo.

The Middle Brook watershed is underlain principally by medium to high grade metamorphic rocks of the Bonavista Bay Gneiss complex (principally a biotite gneiss) with secondary coverage by foliated to massive biotite and muscovite-biotite granite. In the Terra Nova River drainage basin both of the above units predominate with secondary coverage outside the study area by the Gander Lake Group (volcanic rocks, slate, greywacke, siltstone, conglomerate and minor limestone).

Therefore, both stations record flow from watersheds underlain by similar bedrock lithology which is representative of the tectono-stratigraphic Gander Zone. This, therefore, provides two good estimates of ground water recharge and availability, but only for one major geological unit.

5.2 Ground Water Recharge

The annual recharge to the ground water systems may be estimated from the annual discharge of ground water to surface streams assuming no change.

To obtain figures on the annual rates of ground water recharge an initial approximation was made utilizing the minimum monthly flows for each water year of record. These were plotted and the ground water component separated out by joining the lowpoints on the hydrographs. The resultant maximum, minimum and mean annual volumes of ground water discharged are compiled in Table 5-2 for Terra Nova River and Middle Brook.

To further refine the data the mean daily hydrograph record for the mean flow year, as determined above, was obtained (see Figures 5-2 and 5-3). As calculated from these records, the ground water flow was within 10% of the previous calculation.

The results show some variation (19%) between the Terra Nova River (mean of 382 mm - 15 in) and Middle Brook (mean of 313 mm - 12.3 in) but given the difference in watershed size, geology, climate, etc. it is relatively small.

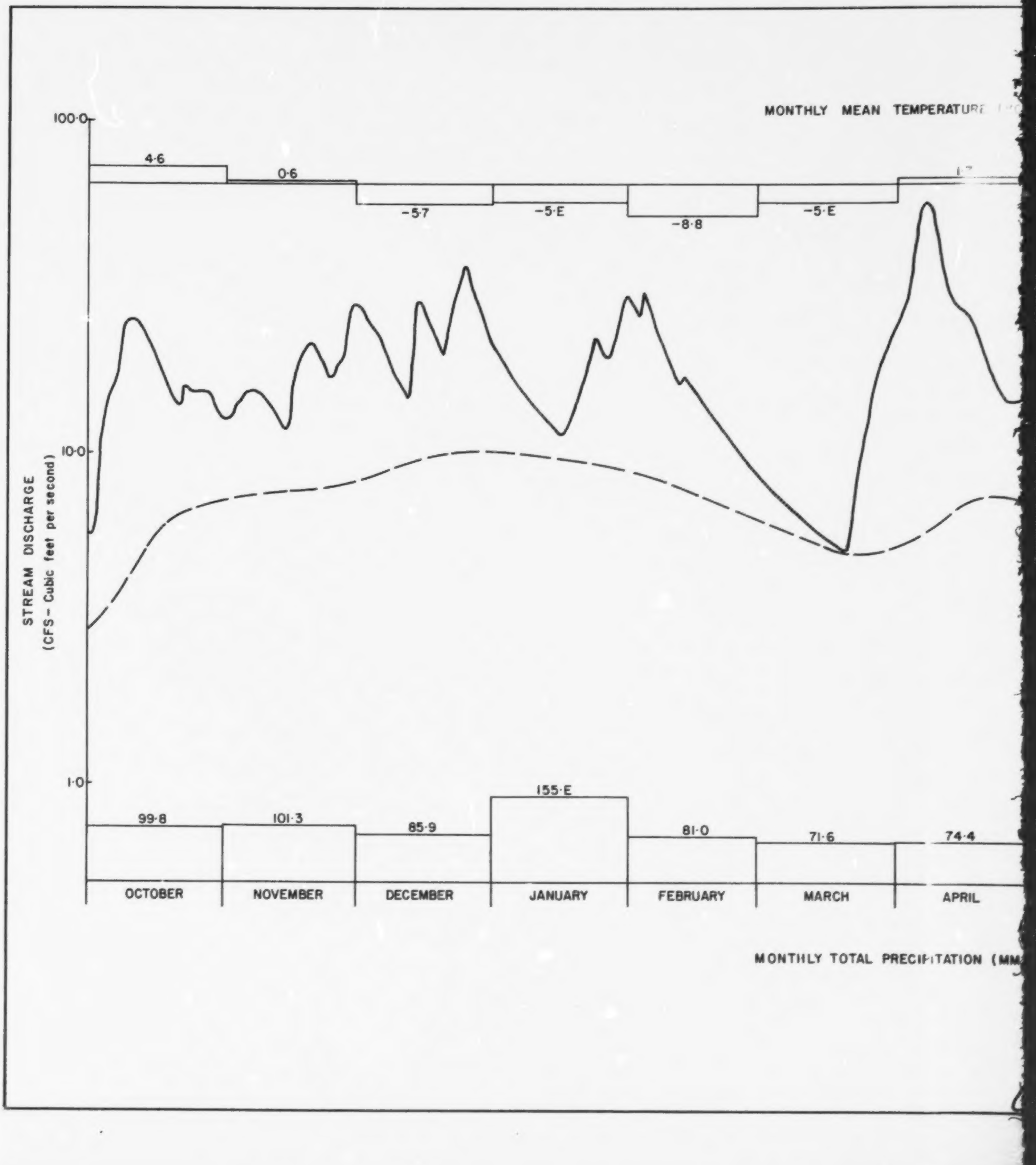
The main problem in utilizing this data is the

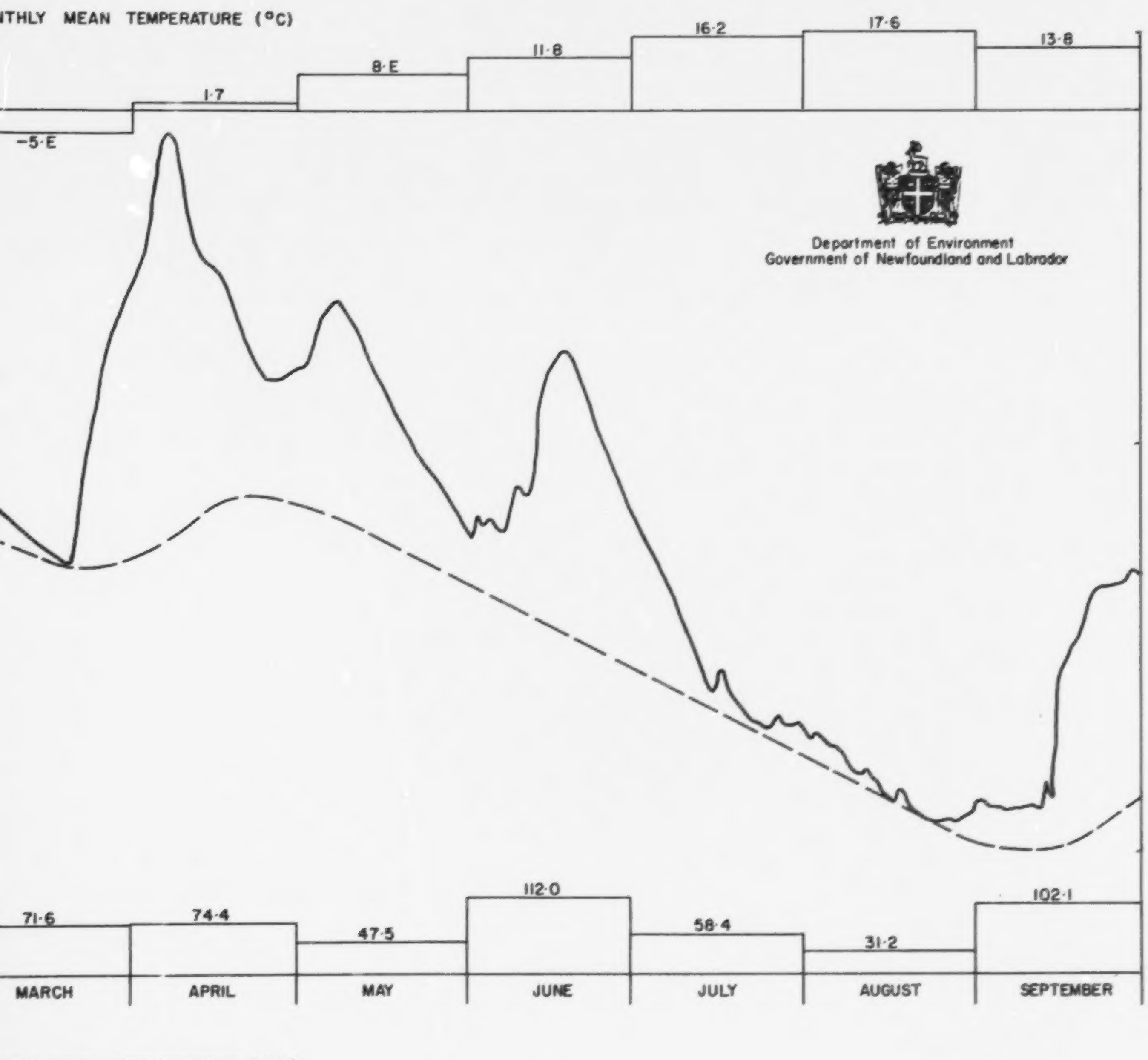
TABLE 5-2

HYDROLOGIC SUMMARY OF WATER YEARS

	Terra Nova River[1]			Middle Brook[1]		
	mm on drainage area			mm on drainage area		
	max.	min.	mean	max.	min.	mean
Total precipitation Year [2]	1346.0 1969-70	920.0 1971-72	1177.5 1975-76	1265.1 1965-66	922.2 1970-71	1093.4 1968-69
Total stream discharge (ground and surface water) Year [2]	1051.3 1969-70	689.6 1973-74	861.0 1966-70	965.4 1969-70	644.9 1966-67	813 1970-71
Total estimated ground water Year	594 169-70	184 1974-75	382 1975-76	458 1968-69	215 1971-72	313 1970-71
Ratio Ground water/precipitation	0.04	0.20	0.32	0.35	0.23	0.29
Ground water/stream discharge	0.57	0.27	0.44	0.47	0.23	0.29

Notes: 1 - 11 year summary 1965 - 1976
2 - year nearest to mean


MONTHLY MEAN TEMPERATURE
100·0
4·6
0·6
-5·7
-5·E
-8·8
-5·E
1·7
STREAM DISCHARGE
(CFS – Cubic feet per second)
10·0
1·0
99·8
101·3
85·9
155·E
81·0
71·6
74·4
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MONTHLY TOTAL PRECIPITATION (MM



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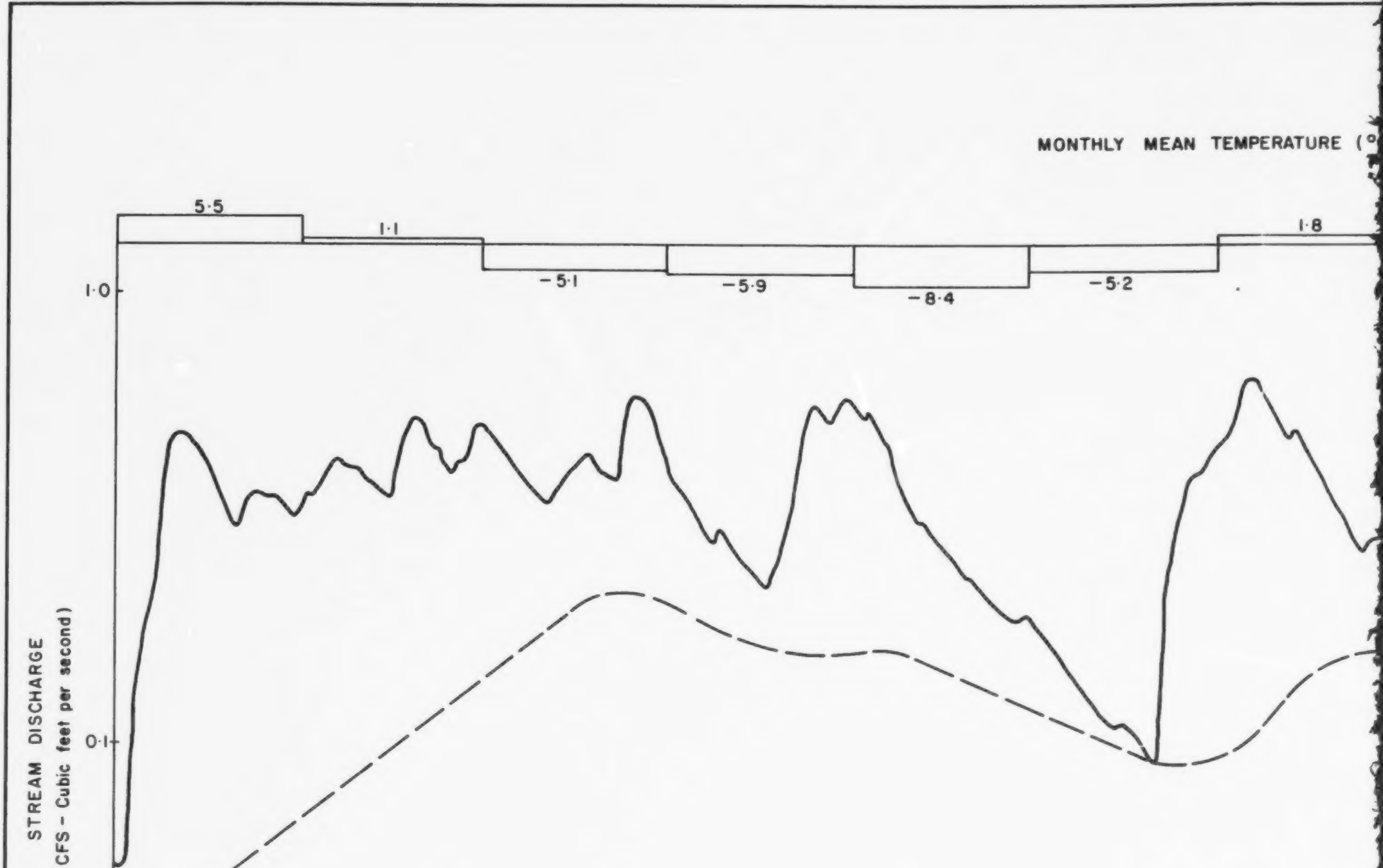
Government of Newfoundland and Labrador

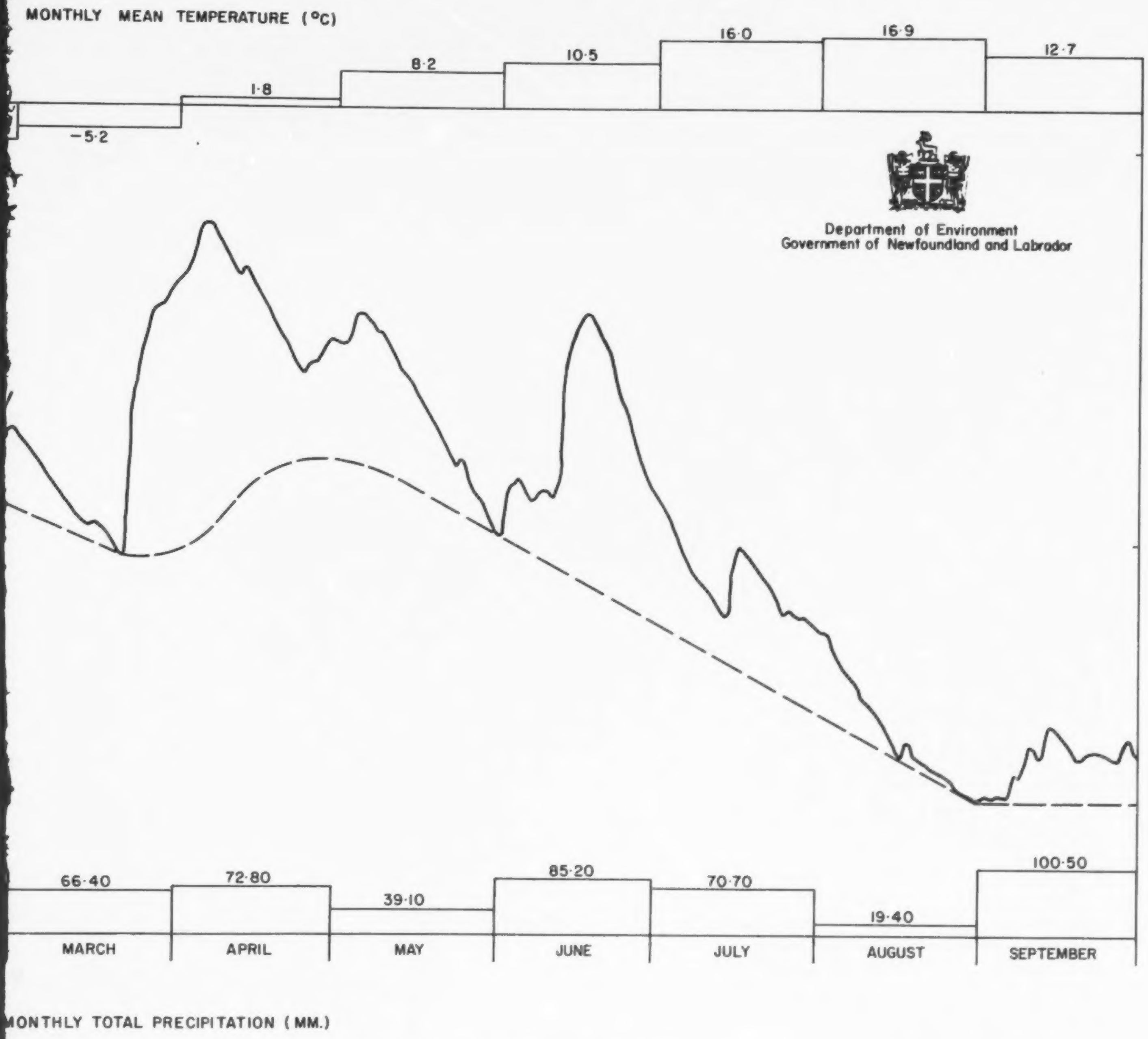
NOTES: Annual mean temperature 4·2° C.
Total precipitation – 1022 mm. E (Estimated value).

HYDROGEOLOGY OF BONAVISTA BAY AREA

Figure 5-2
Mean daily hydrograph record for Terra Nova River
(For mean flow year, 1975 – 1976)

NOLAN, DAVIS & ASSOCIATES LIMITED


MONTHLY MEAN TEMPERATURE (°
5·5
1·1
-5·1
-5·9
-8·4
-5·2
1·8
1·0
0·1
STREAM DISCHARGE
(CFS - Cubic feet per second)
188·21
150·62
120·90
168·10
94·30
66·40
72·80
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MONTHLY TOTAL PRECIPITATION (M



Department of Environment
Government of Newfoundland and Labrador

NOTES: Annual mean temperature 4·0°C.
Total precipitation—1176·2mm.

HYDROGEOLOGY OF BONAVISTA BAY AREA

Figure 5-3
Mean daily hydrograph record for Middle Brook
(For mean flow year, 1975-1976)

NOLAN, DAVIS & ASSOCIATES LIMITED

TABLE 6-1

GROUND WATER QUAL

Location	Date MO/YR	Source	Geological Unit	pH	Ca	Mg	Na	Alkalinity	Hardness	SO_4	Cl	Nitrate
Bonavista		ADB	5		22.2	12.3	87.0	23		42.6	159.1	3.7
Bonavista[1]		ADB	5		29.1	13.2	117.2	255		22.1	81.9	
Bonavista	9/72	DOE	5	6.08	16.2	1.5			40.5		69.2	6.8
Bonavista	3/73	DOE	5	5.2	2.72	0.93		0.6			10.03	
Cannings Cove	9/73	NDAL	5	8.3	25.1	1.23			68.0			.016
Cannings Cove	12/73	NDAL	5	7.93							10.14	.088
Catalina		ADB	5		18.0	13.1	36.6	110		27.4	28.4	
Dunfield	9/79	NDAL	5	7.34	5.54	1.95		49.6	25.3	5	23	.00
Dunfield	9/79	NDAL	5									.00
Dunfield	4/80	NDAL	5	7.37	7.78	1.57	9.46	25.4	26.16	12.4	15	
Elliston	3/76	NDAL	5	7.72							96.1	.08
Elliston		ADB	5		3.6	3.9	18.9	25		11.0	20.9	
Musgravetown	3/80	NDAL	5	7.0	15.5	1.29	9.86	44.7	45.1	7	6	
Musgravetown	3/80	NDAL	5	8.02	14.8	1.39	10.29	44	42.8	8	7	
Tickle Cove	3/74	NDAL	5	6.65	7.1	24.7			156.6		95.0	0.0

NOTES: all values in mg/l unless otherwise specified
alkalinity and hardness as $CaCO_2$
nitrate, nitrite & kjel nitrogen as N
color as true color units (T.C.U.)
ADB - Atlantic Development Board Report
DOE - Department of Environment
NDAL - Nolan, Davis & Associates Limited
DATE - month/year

TABLE 6-1

GROUND WATER QUALITY DATA

Alkalinity	Hardness	SO_4	Cl	Nitrate	Nitrite	Kjel Nitrogen	F	Fe	Mn	Cu	Pb	Zn	Color	TDS	Turbidity	Conductivity
23		42.6	159.1	3.7												
255		22.1	81.9													
	40.5		69.2	6.84	.005		.08	.68						572		269
0.6			10.03					.03	.01	1.97	0.01		30		.80	
	68.0			.016[2]				.06	.01		0.00		5	93	.55	162.1
			10.14	.088				.17	TR				5	114	47.0	202.2
110		27.4	28.4													
49.6	25.3	5	23	.005				1.84	.04		.025		200	106	20.0	143.1
				.005				.78	.025				55	75	7.1	
25.4	26.16	12.4	15			.189		.15	.01		.01		10	50	7.9	94.5
			96.1	.084				.13	.40				5	368[3]	.75	538.9
25		11.0	20.9													
44.7	45.1	7	6			.275		.55	.04		.01		20	87	25	126.7
44	42.8	8	7			.208		.09	.01		.01		5	70	1.5	129.1
	156.6		95.0	0.0				16.95	1.78		.02		5	1944	77.0	640.2

TDS - total dissolved solids
turbidity as Jackson Turbidity Units (J.T.U.)
conductivity as microhos/cm
TR - trace
1 - Alkalinity, Na & Cl - Values may be estimates
2 - $NO_3 + NO_2$
3 - TDS + TSS

TABLE 6-1 co

GROUND WATER QUA

Location	Date MO/YR	Source	Geological Unit	pH	Ca	Mg	Na	Alkalinity	Hardness	SO_4	Cl	Nitrate
Fogo		ADB	15		35.2	17.5	33.5	67.8		23.2	66.6	
Fogo	8/73	DOE	15	8.25	4.84	.94	24.5	47.2	15.9	4.5	10.0	.
Eastport		ADB	3		7.0	1.60	4.7	11.0		2.9	6.8	
Salvage	11/79	NDAL	3	8.04	31.1	6.34		70.6	104			
Terra Nova		ADB	17		10.4	3.6	15.3	34.6		1.3	10.2	
Terra Nova		ADB	17		7.0	2.0	6.3	20.2		1.6	1.9	
Trinity (B.Bay)	3/74	NDAL	1	7.32	14.0	3.64		44.0	50.2		15.3	1.8
Trinity (B.Bay)	3/74	NDAL	1	6.49	.47	.60		2.8	3.78		10.2	.00
Trinity (B.Bay)	3/74	NDAL	1	6.15	.43	.58		.80	3.68	2.29	8.79	.16

NOTES: all values in mg./l unless otherwise specified
alkalinity and hardness as $CaCO_3$
nitrate, nitrite & kjel nitrogen as N
color as true color units (T.C.U.)
ADB - Atlantic Development Board Report
DOE - Department of Environment
NDAL - Nolan, Davis & Associates Limited
DATE - month/year

TABLE 6-1 cont'd

GROUND WATER QUALITY DATA

Alkalinity	Hardness	SO_4	Cl	Nitrate	Nitrite	Kjel Nitrogen	F	Fe	Mn	Cu	Pb	Zn	Color	TDS	Turbidity	Conductivity
7.8		23.2	66.6													
7.2	15.9	4.5	10.0	.005	.005		.05	4.4	.035	.011	.01	.052	ND	90	.67	158
1.0		2.9	6.8													
0.6	104					.047		.01	.06		.01		7.5	222	.45	396.7
4.6		1.3	10.2													
0.2		1.6	1.9													
4.0	50.2		15.3	1.82				.08	.022				5	87	.35	137.2
2.8	3.78		10.2	.004				.05	.03				10	44	1.07	26.4
80	3.68	2.29	8.79	.16				.08	.036				10	52	1.30	25.7

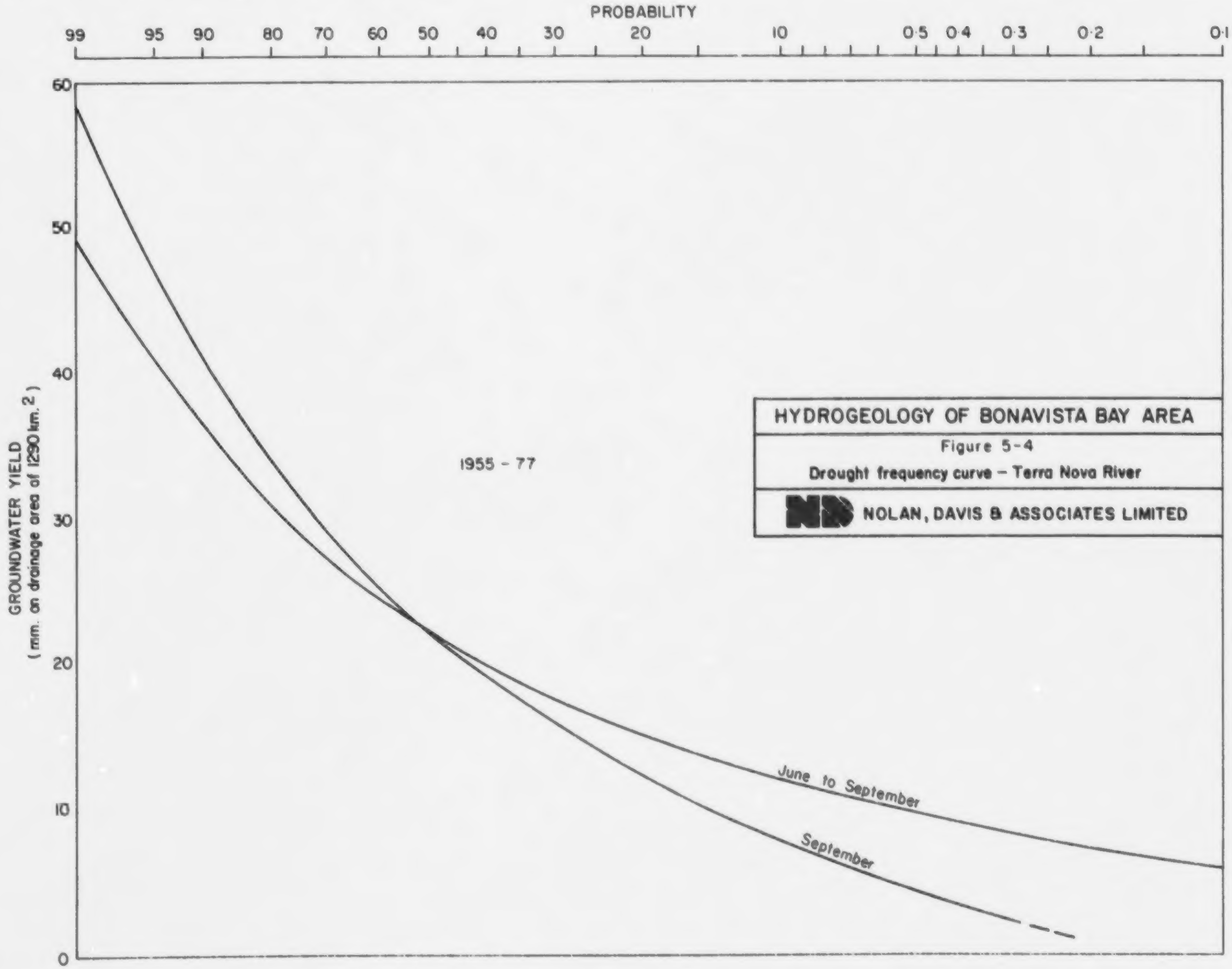
TDS - total dissolved solids
turbidity as Jackson Turbidity Units (J.T.U.)
conductivity as micromhos/cm
ND - not detected

large percentage of both watersheds covered by lakes which will act to augment minimum flows. The analytical tool utilized cannot differentiate ground water flow from lake augmentation. Until further data becomes available to make this differentitation, it is suggested that the minimum annual values be utilized to represent ground water recharge. Therefore, recharge over this granitic-metamorphic geologic unit should be in the range of 184 mm - 215 mm/yr (7.2 - 8.5 in/yr) or 20 - 23% of the total precipitation.

Consequently, using the Terra Nova River as an example, 184 mm (7.2 in) on a drainage area of 1290 km^2 (498 mi^2) would produce 237 x 10^6 m^3 (52.1 x 10^9 gal) of ground water recharge.

5.3 Availability to Surface Water Users

To determine the availability of ground water for utilization from surface water intake structures, the drought frequency curves for the Terra Nova River and Middle Brook were computed and plotted, Figures 5-4 and 5-5 respectively. The figures show both the drought frequency curve for September, and the drought frequency curve for the total yield of the four summer months, June



HYDROGEOLOGY OF BONAVISTA BAY AREA

Figure 5-4

Drought frequency curve – Terra Nova River

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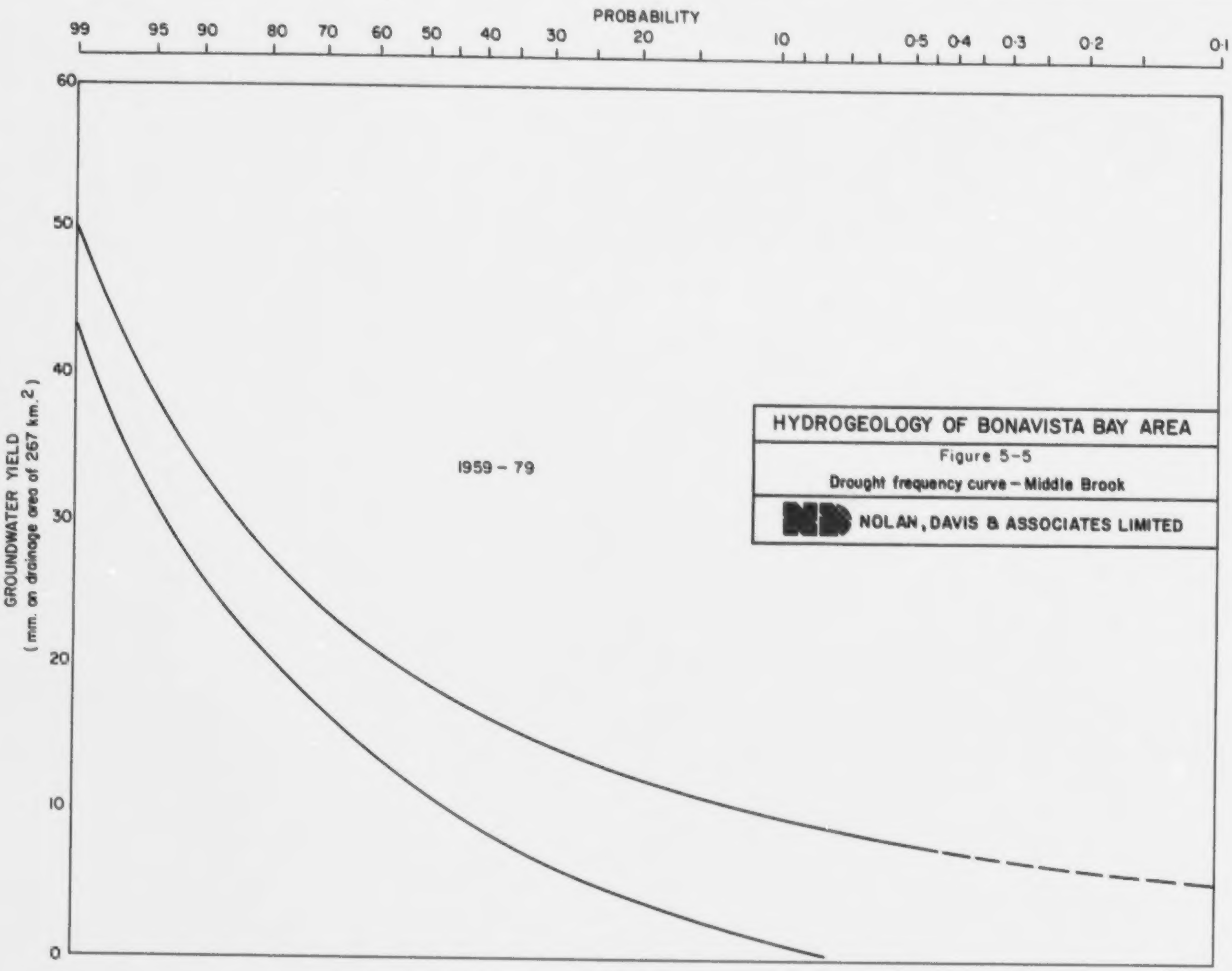


HYDROGEOLOGY OF BONAVISTA BAY AREA

Figure 5-5

Drought frequency curve - Middle Brook

NOLAN, DAVIS & ASSOCIATES LIMITED

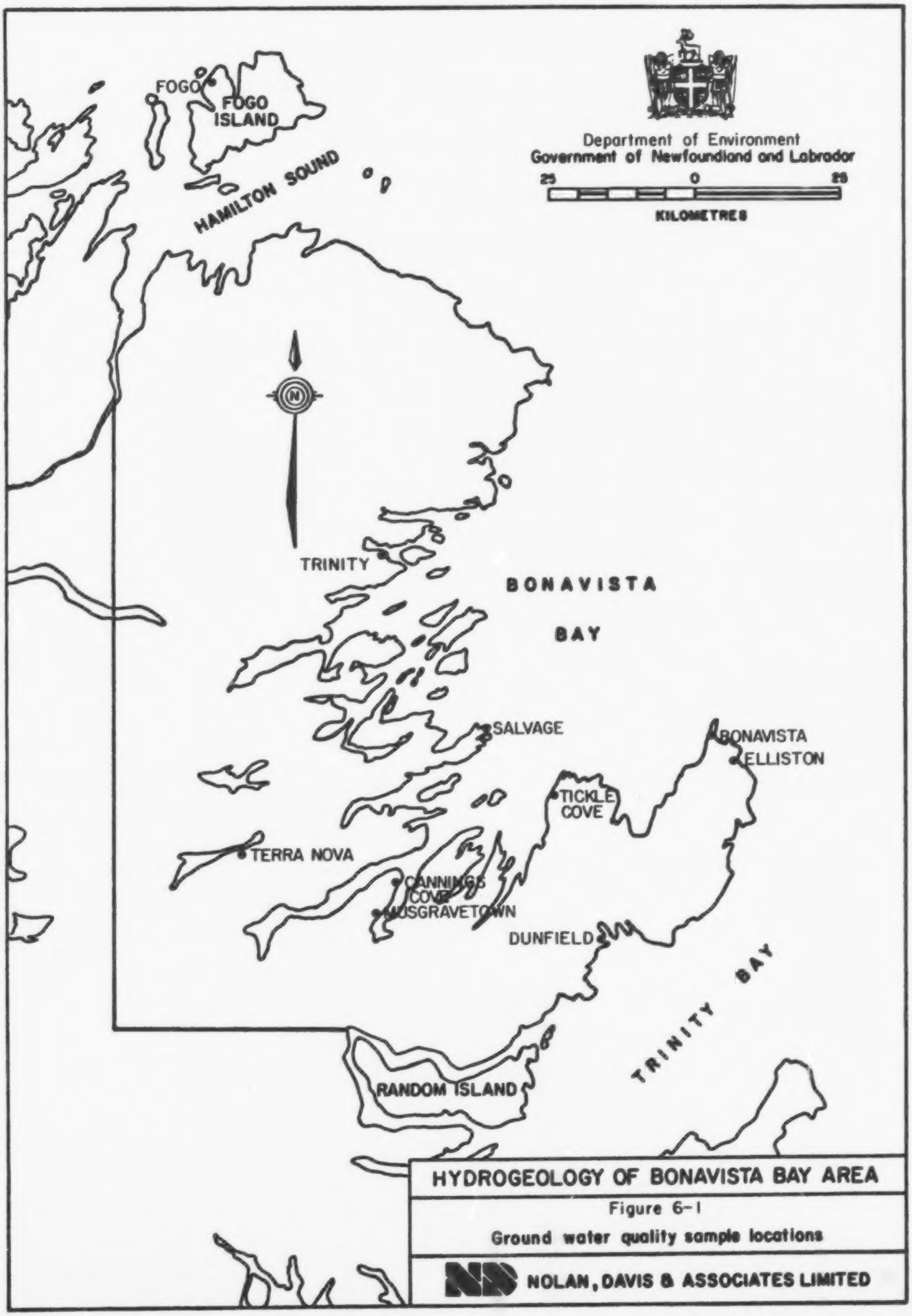
to September inclusive. The first curve shows the probability of a given yield during approximately the dryest month. For the lower discharges, these yields may be accepted as ground water (augmented by lake flows); for higher yields, part of the flow probably is surface water. The yield of the four months may be considered as an indication of what might be stored in a small storage facility which could hold some of the peaks but probably could not contain the water from spring break-up.

6 WATER QUALITY

6.1 Ground Water

A total of twenty-four chemical analyses were available from various communities within the study area (see Figure 6-1). In almost all cases these samples were collected from drilled bedrock wells. The usefulness of the data is restricted, largely because 46% of the samples did not have all major ions determined; while 50% of the samples had no information on sample collection, preservation, well depth and geology. Table 6-1 summarizes the data as completely as possible.

Most of the data from Nolan, Davis & Associates


FOGO
FOGO ISLAND
HAMILTON SOUND
Department of Environment
Government of Newfoundland and Labrador
25
0
25
KILOMETRES
N
TRINITY
BONAVISTA BAY
SALVAGE
BONAVISTA
ELLISTON
TICKLE COVE
TERRA NOVA
CANNINGS COVE
MUSGRAVETOWN
DUNFIELD
TRINITY BAY
RANDOM ISLAND

HYDROGEOLOGY OF BONAVISTA BAY AREA

Figure 6-1

Ground water quality sample locations

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Limited (NDAL) was collected during aquifer tests, consequently, in all cases the well was pumped prior to sample collection; well depth information was generally available for these wells. Six of the samples (Bonavista and Fogo - ADB samples, Elliston and Tickle Cove - NDAL samples, and Fogo and Bonavista - DOE samples) have obvious water quality problems associated with them. These problems are related to elevated chloride, nitrate, iron, TDS (with associated color, turbidity and conductivity values) and manganese values.

In most cases the elevated chloride (and when analyzed sodium) values are suggestive of either sea water intrusion or road salt contamination. With increases in chloride, the ionic strength of the ground water is increased, consequently, the solubility of other parameters such as iron, manganese and nitrate will be enhanced. Thus sea water or road salt problems may produce other associated problems - like elevated iron. Such problem samples cannot be considered typical of natural ground water quality in their respective geologic units. Because of the lack of data, generally no attempt was made to characterize the hydrostratigraphic units in terms of ground water quality.

Within the Musgravetown Group, the ground water quality can be classified as either representative of sodium-bicarbonate ($Na^+ - HCO_3^-$) or calcium-bicarbonate ($Ca^{2+} - HCO_3^-$) type waters. In a few cases the iron values are slightly elevated relative to the .3 mg/l maximum acceptable concentration established by Health and Welfare Canada (1978). Based on the water quality data in Table 6-1 the ground water quality from the Musgravetown Group can be considered quite good.

Based on the available analytical parameters, the water quality from the Connecting Point Group and the Devonian granites can be considered as either $Ca^{2+} - HCO_3^-$ or $Na^+ - HCO_3^-$ type waters. Reportedly chemical problems (typically iron and manganese) are quite common in wells drilled on Fogo Island and in the northeastern portion of the study area (Mr. Roswell, Department of Public Health, personal communication). However no specific information is available and it is not known whether these problems reflect natural ground water quality or are associated with other problems like sea water intrusion. From the Connecting Point Group three samples were collected in Trinity (Bonavista Bay). The initial sample was collected from a drilled well and is characteristic of a $Ca^{2+} - HCO_3^-$ type water; the latter samples were apparently collected from dug wells and can be classified as $Mg^{2+} - Cl^-$

(magnesium-chloride) type waters.

6.2 Surface Water

6.2.1 Introduction:

Available surface water quality data originates from two distinct sources, either miscellaneous samples collected irregularly or as part of the Newfoundland Department of Environment's Provincial Water Quality Network. Figure 6-2 indicates the sample locations.

Unfortunately a number of problems arise in trying to deal with the data; including:

1) The sample analyses are far from complete, in fact, few of the total number of samples have been analyzed for complete major ion chemistry.
2) The large errors (3% - 44%) in ion balances are thought to be due to a combination of a) a low total milliequivalents, b) lab analysis undertaken on unfiltered samples and c) the apparent presence of relatively high dissolved organic concentrations.
3) The location of the samples is poorly defined with respect to geologic controls, chemical treatment,

location within the distribution system, etc.

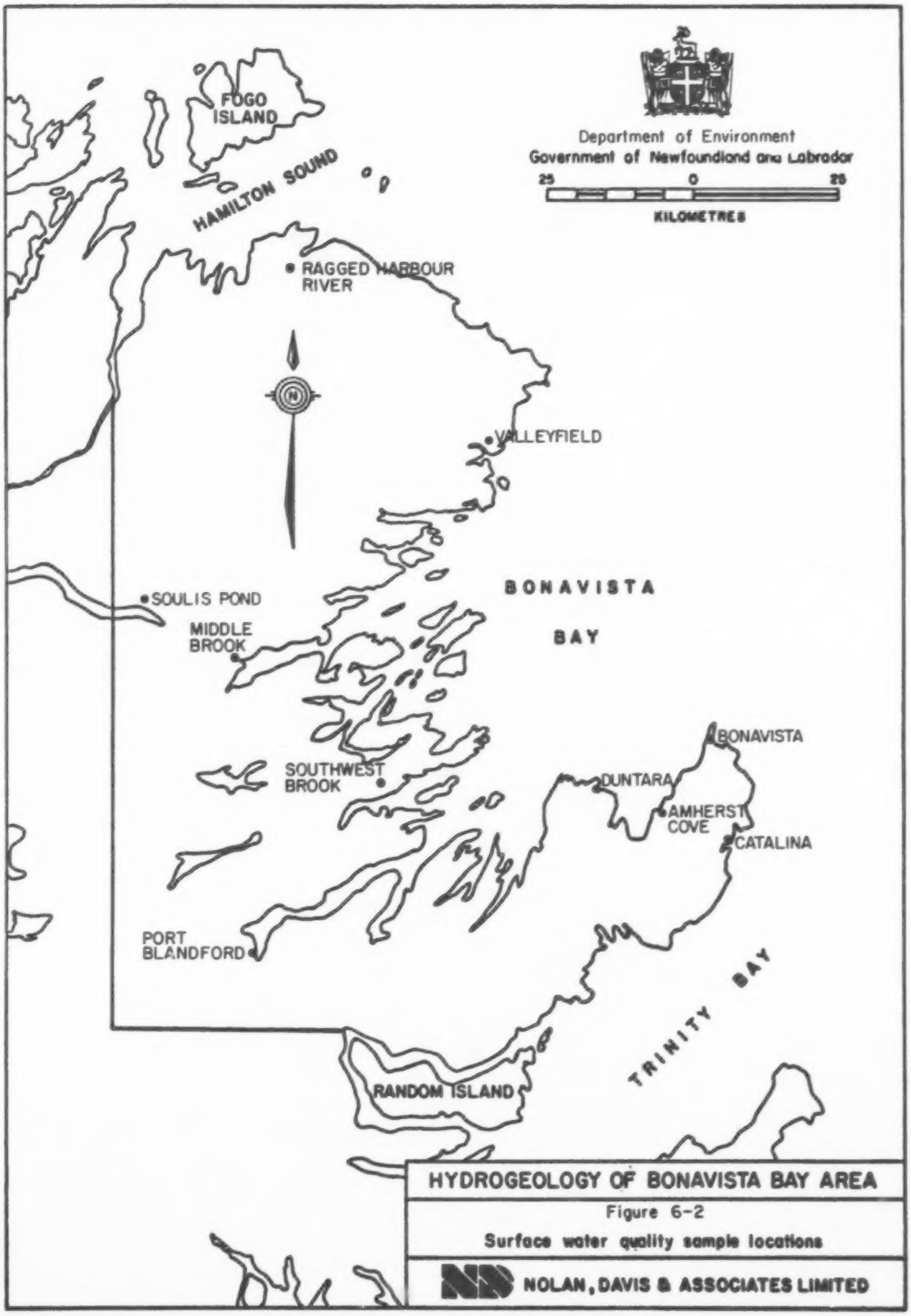
4) No discharge data is available and this can have a substantial influence on surface water chemistry.
5) Typically the surface waters within the study area are brownish colored, thus indicating the presence of organic acids which complicate the interpretation of water chemistry data.

6.2.2 Miscellaneous Data:

A total of fifteen surface water chemistry samples are available from miscellaneous sources. As a consequence of the forementioned problems, no attempt was made to interpret the results of the surface water quality data.

6.2.3 Provincial Water Quality Network Data:

Under the Department of Environment - Provincial Water Quality Network, four main surface water quality sampling stations have been established. Regular sampling commenced at all four stations at a general frequency of once per month. The number and type of parameters monitored varies with each sample. Although each site is guaged, simultaneous discharge readings were not available for specific samples.


Department of Environment
Government of Newfoundland and Labrador
25
0
25
KILOMETRES
FOGO ISLAND
HAMILTON SOUND
RAGGED HARBOUR RIVER
N
VALLEYFIELD
SOULIS POND
MIDDLE BROOK
BONAVISTA BAY
SOUTHWEST BROOK
BONAVISTA
DUNTARA
AMHERST COVE
CATALINA
PORT BLANDFORD
TRINITY BAY
RANDOM ISLAND

HYDROGEOLOGY OF BONAVISTA BAY AREA

Figure 6-2

Surface water quality sample locations

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Again the interpretation is hindered by the five forementioned problems, nevertheless, several comments can be made with regard to chemistry and water quality.

1) All four stations constantly record a fresh, soft corrosive Na-Cl type water. This is thought to result from the relatively insoluble bedrock aquifers underlying the drainage basins and the predominance of marine aerosols in precipitation due to the proximity of the ocean.

2) There are no major well defined seasonal trends in pH, TDS or major ion chemistry. The sampling record is too short and the sampling too infrequent to determine long term trends, i.e. effect of acid rainfall.

3) Seasonal fluctuations in water temperatures range from 0°C (generally January to March inclusive) to 18° - 20°C (generally in August).

4) There is no apparent trend in total dissolved solids with watershed size.

5) pH values range from 5 - 6.5 at each station over

the sample record, with no noticeable acid slug effect from spring melts.

6) Nearly all parameters analyzed meet the maximum acceptable standards of the Guidelines for Canadian Drinking Water Quality (1978). Parameters usually exceeding the limits are colour, ranging from 10 - 150 (limit is 15 TCU), iron .05 - 1.7 mg/l (limit is .3 mg/l) and manganese .02 - .16 mg/l (limit is .05 mg/l).

7) Total coliform bacterial concentrations are found over the range of 7 to 1600 per 100 ml; but fecal coliform counts occur with much less frequency, and when present may range from 1 to 600 per 100 ml but usually are less than 50 per 100 millileter. These are well within the range expected in natural wooded conditions.

7 GROUND WATER CONTAMINATION

7.1 Introduction

The potential for contamination of surficial and bedrock aquifers must always be realized and this is especially important in areas where communities and individuals are entirely dependent upon ground water for an economical source of potable water.

Generally wells in the Bonavista Bay area are no more or less susceptible to contamination problems than other areas of the province. However, the peninsula area between Bonavista Bay and Hamilton Sound is an exception, especially with regard to dug wells; this is due to both the lack of overburden and the number of bog areas.

The contamination sources that will be discussed represent potential hazards to all ground water users whether they are located in Bonavista Bay or elsewhere. However, each potential source is discussed, whenever possible, within the context of the existing conditions in the Bonavista Bay study area.

7.2 Contaminant Sources

7.2.1 Sewage Effluent:

This includes contamination from septic disposal fields, septic tanks and pit privy systems, all of which are utilized throughout the study area. These systems produce a sewage effluent that most notably contains surfactents (detergents), phosphate, nitrate and bacteria (including pathogens). Most ground water contamination problems that arise are related to the presence of either nitrate and/or bacteria. On-site septic disposal systems function properly in areas where a sufficient thickness of reasonably permeable overburden (eg. silt/sand) exists. In portions of the study area where there is little or no surficial material over bedrock, or the surficial material is very permeable (eg. gravel), or the surficial material has a very low permeability (eg. clay) problems will arise. These problems generally relate to flow of effluent along the bedrock or surficial material surface or rapid flow through the surficial materials to the well. Location of the septic disposal system up-gradient or within the hydraulic influence of the well can also cause problems even in the most suitable surficial materials.

In many locations throughout the study area and especially in the northeastern portion, many septic disposal fields and tanks are either directly or indirectly connected to the coast. Thus the acceptability of an on-site sewage disposal system can only be judged on the basis of local conditions.

The contamination potential to either shallow dug wells or drilled wells increases with the density of sewage disposal development. Within the Bonavista Bay area many homes depend upon dug wells, and it is these wells that are most often affected by sewage effluent.

With the installation of central water services throughout the study area, the incidence of well contamination problems has been reduced considerably.

7.2.2 Well Construction:

Strictly speaking, well construction problems are not so much a source as a cause of ground water contamination problems. Contamination of both dug and drilled wells can be attributed to well construction. Within the Bonavista Bay area well construction is a major factor in the contamination problems that arise.

The use of dug wells, both in the past and present, is widespread. Many of the wells in the study area, especially in the smaller centers, are quite old. The number of dug wells that could be considered as "properly" constructed is likely to be small either because of economics, traditional precedent or logistics (i.e. overburden too thin, etc.). In some areas the dug well only consists of a covering over a bedrock spring or a bedrock depression/ excavation into which surface and shallow ground waters can collect. This will have produced dug wells that 1) are not properly lined or gravel packed; 2) have no concrete or cement apron around them; 3) have tops which are level with the ground surface; 4) have no tops or are not properly covered; 5) are not situated properly with respect to possible contamination sources; and 6) are not checked, cleaned or maintained on a regular basis. In most cases it is only the rural setting that enables many of the dug wells to operate unaffected by contamination.

Drilled wells are generally, but not necessarily, less susceptible to various contaminant sources. Proper construction techniques are perhaps more important for drilled wells when one considers the cost involved. Generally problems with drilled wells will arise because 1) an insufficient amount of casing is used during construction; 2) drive shoes are not used to seal the casing tightly into the bedrock; 3) leakage caused by improper welding of casing joints; 4) failure to cement grout the annular space or fracture zones beneath the casing, within the uppermost bedrock surface, thus ensuring a tight bedrock seal; and 5) lack or improper use of well seals.

The most evident problem within the Bonavista Bay area, based on the drillers' logs, is the use of insufficient casing. Normally less than 3 m (10 ft) is used in well construction and very frequently less than 1.5 m (5 ft) is used. Typically, an upper bedrock surface is extensively fractured and unless casing is installed below this fractured surface, contaminants that may reach this surface cannot be prevented from entering the well through interconnected fractures.

Undoubtedly problems related to well construction are prevalent throughout the study area but because they are not recognized and/or reported little information exists. In areas where well construction problems truely do not exist, either the low level of urban development or the installation of central water services are likely responsible.

7.2.3 Road Salt:

The application of salt or salt/sand mixtures for winter de-icing purposes has frequently resulted in sodium and/or chloride contamination of drilled and especially shallow dug wells. The prevalence of 1) ribbon-type housing development throughout the Bonavista Bay area; 2) the practice of locating wells close to the road; 3) the construction characteristics of wells, particularly dug wells; and 4) the thinness of the surficial materials; all provide the potential for occurrence of road salt problems within the study area. Depending on the nature of the flow system, down-gradient contamination of wells may not occur for months after road salt applications have stopped, as the contaminants are flushed through the local flow system. Chemically it is difficult to distinguish between chloride and sodium produced by road salt, sea water intrusion or natural ground waters from salt bearing geological formations.

Reportedly there have been approximately 80 - 100 complaints made about road salt contamination of wells within the study area over the past 5 - 6 years (L. Warren and Mr. Noseworthy, Department of Transportation, personal communication). The complaints typically involve dug wells (old and new) located on the down gradient side of a paved road (often a newly paved road). These complaints are most prevalent in the spring. The investigation, processing and compensation involved in such cases is done by the Department of Transportation personnel, often the Departments of Environment and Public Health are not informed of such problems.

Annually throughout the study area, an estimated 11,800 to 12,700 tonnes (13,000 to 14,000 tons) of salt and 4,500 tonnes (5,000 tons) of a sand-salt mixture is used for de-icing. The latter is used almost exclusively on unpaved roads at mixtures of 15%/85% or 25%/75% of salt/sand respectively.

7.2.4 Sea Water Intrusion:

This potential problem is of obvious concern when wells, particularly drilled wells, are being constructed along the coast; and should be more of a concern in the heavily populated portions of the study area. A well's susceptability to this problem depends largely upon 1) its proximity to the coast; 2) the depth of the well; 3) the dip of the geologic formation; 4) the position of fracture zones within the well; and 5) the pumping rate.

As previously discussed local flow systems predominate along the coast and will direct ground water flow toward the sea. Consequently the hydraulic head acting on most coastal wells may be sufficient to prevent encroachment of sea water to the well. However, depending on the pumping rate and proximity to the coast, reversals in the hydraulic gradient may occur and sea water could be induced into a well (or wells). Decreasing the pumping rates, driving the casing deeper to seal off sea water bearing formations or fracture zones and grout sealing of such zones may be utilized in dealing with sea water intrusion problems.

Development of communal ground water systems for coastal communities should be encouraged to seek well locations as far inland as practical. To date sea water intrusion has apparently not been a problem within the Bonavista Bay area although there are many coastal population centers that depend on ground water. Whether such problems actually do not exist or only go unreported is not known.

7.2.5 Hydrocarbon and Chemical Spills:

Hydrocarbon spills frequently produce contamination of ground water supplies. Generally, these spills are related either to the loss of relatively small, typically 227 to 455 liters, (50 to 100 gal), quantities of heating oil by homeowners; or the loss of gasoline, often in considerable quantities, from subsurface storage facilities. Such spills can ruin either individual or communal water supplies for tens of years. The presence of thin, permeable surficial deposits and/or the dominance of fracture flow, means there will be little to retard the vertical or lateral migration of such hydrocarbons. Proper siting of domestic oil tanks and periodic inspection, maintenance and installation of seepage detection devices on gasoline tanks, will reduce such hydrocarbon spills. Only a few domestic problems have been reported although many probably go unreported.

Today more than ever, the handling and use of hazardous and toxic chemicals is commonplace. Some of these chemicals such as pesticides, herbicides, de-greasing agents, PVC's, etc. are toxic in concentrations of mg/g (microgram per gram, approximately equal to part per billion - ppb). Consequently even a small spill measured in tens of liters can permanently destroy the usefulness of an aquifer over large areas. Persons handling or working with such chemicals should be instructed in the potential dangers associated with them to ensure their proper handling and storage. To date there have been no reports of such spills involving harzardous or toxic chemicals within the study area.

In the event of either a hydrocarbon or chemical spill only immediate action will provide an opportunity to limit the resulting effects on ground water. Clean-up procedures should include immediate excavation and removal of contaminated surficial material and establishment of an hydraulic gradient, through pumping, to control lateral and possibly vertical migration of the contaminant.

7.2.6 Solid Waste Leachate:

All solid waste disposal facilities (sanitary landfills, modified landfills, "dumps", etc.) produce a fluid by-product referred to as leachate. This fluid is produced by precipitation that migrates downward through the surficial materials dissolving soluable organic and inorganic components of the waste material; and the evolution of gases such as H_2S and CH_4 during decomposition of organic materials. This leachate will eventually enter the water table and be carried along in the direction of natural ground water flow. The chemical composition of leachate will vary according to the nature of the waste material. Depending on the type of geologic materials and chemical character of the ground water, attenuation of the leachate is possible. Proper site selection, design and maintenance of such disposal facilities will minimize the effect on surrounding ground water supplies.

Generally waste disposal within the study area is accomplished by incineration or localized dumping followed by some form of burial. The latter method of waste disposal is very primative and the only merits associated with it are economic. Only the remoteness of such sites from local population centers and the generally low development density throughout the study area enables such practices to exist. However the leachate plumes generated by such sites, including more elaborate facilities such as those at Terra Nova, may eventually restrict or prevent development of ground water or even surface water supplies within their radius of influence.

Within the Bonavista Bay area leachate is apparently not effecting currently utilized ground water supplies. However, leachate migrating within a surficial aquifer, near the Terra Nova regional waste disposal facility, has been identified (Robinson and Lethbridge, 1979).

8 FUTURE GROUND WATER USE AND DEVELOPMENT

Presently the ground water resource is primarily utilized by individuals to meet domestic needs and generally this utilization, for economic reasons, relies upon shallow dug wells. Although some communities such as Eastport, Ferryland, Plate Cove West and Salvage depend upon ground water as a source of supply, most communities exploit surface water. Frequently a community's ability to obtain a central water system is hampered by the prohibitative capital costs of establishing a surface supply system. This may be caused by 1) the potential source being too far removed from the population center; 2) the requirement for expensive treatment facilities to enable utilization of an adjacent supply; 3) the susceptibility to man's activities of such exposed sources - acid precipitation, eutrophication, sedimentation, etc.; and 4) the restriction of development often within a relatively large area of the source of supply. Often ground water is overlooked as a potential source of supply because it appears to be less well understood and therefore unreliable or it is assumed it cannot meet the required demand.

Typically the location, development, testing and design of a ground water supply is haphazard within the Bonavista Bay area. Often wells (other than domestic) are drilled without regard for their location, the type of well construction, delineation of the production zones, the isolation of potential contaminant zones, and the proper development and testing of the ground water supply. Such an approach to development of a ground water supply system indicates a lack of both understanding and planning.

Within the surficial material there are instances where relatively large yields have been obtained, however in most cases the yields reported are substantially less than those that could be achieved with proper control of well construction and development. The construction of surficial wells in the Terra Nova area, as indicated in Appendix A, is typical of surficial wells in the Bonavista Bay area, i.e. the entire well is cased with no screen. In these outwash deposits or other suitable saturated materials high yielding wells are possible with proper drilling supervision, construction and development procedures. Similarly, larger than average yields are possible for wells drilled in bedrock. The unusually large yielding wells located at

Bunyon's Cove, within the meta-volcanic Love Cove Group, prove that even in typically low yielding formations, given the right conditions larger yields can be obtained.

Both municipal and industrial development depends upon the availability of water supply systems. The ability of ground water sources to meet these needs in many, though certainly not all cases, is currently not recognized although the potential does exist.

9 CONCLUSIONS

Ground water use is widespread throughout the entire study area but is developed to the greatest extent within the Bonavista Bay Peninsula. While a few communities depend entirely upon ground water as a source of supply, individuals utilizing shallow dug wells exploit ground water to the greatest extent. No figures are available for the numbers or distribution of dug wells however the use of drilled wells is increasingly annually.

Information on the surficial aquifers within the Bonavista Bay area is generally lacking. No dug well and little drilled well information, coupled with incomplete mapping of the surficial deposits, makes it impossible to quantify, except in the broadest terms, the ground water potential of these deposits. The outwash sand and gravel deposits which comprise the surficial Hydrostratigraphic Unit S2 offer the greatest ground water potential with maximum reported yields estimated at 273 and 182 lpm (60 and 40 gpm) for the Carmanville and Terra Nova areas respectively. No quantative information is available for Unit S1; however it is likely that yields within Unit S1 will range between 0 and 9 lpm (0 and 2 gpm) in most cases. Although Unit S2 could potentially yield large volumes of ground water, the saturated thickness of this unit will control its productivity.

Hydrostratigraphic Unit 5, which consists of the sedimentary Musgravetown Group, is the most productive with mean ground water yields of 28.6 lpm from a mean depth of 44.7 meters. The mean yield, based on the drillers' estimates, is generally supported by the results of eight short duration aquifer tests within the Musgravetown Group. The range in ground water yields of 0 - 409 lpm is the largest within the study area. More wells have been drilled in this unit than all other hydrostratigraphic units combined.

The Devonian or earlier granitic and mafic rocks of Hydrostratigraphic Unit 4 is next in terms of ground water productivity, with a mean yield of 26.4 lpm; the mean yields for Units 3, 2 and 1 decreased sequentially with values of 18.2, 10.5 and 1.1 lpm respectively. These hydrostratigraphic units have yields that are more or less suitable for domestic uses but in most cases not appropriate for municipal or industrial applications. Hydrostratigraphic Units 5 and 4 may provide sufficient quantities for low demanding municipal and industrial applications.

Ground water quality within the various bedrock aquifers is not well defined. Values for iron and manganese; the constituents that are most often responsible for quality degradation; are usually within the maximum acceptable limits based on the available data. In most cases, elevated values of chloride and sodium are indicative of sea water or road salt problems. Elevated chloride values may produce additional problems like increased iron concentrations. Virtually no information is available on the ground water quality in the surficial aquifers.

Several problems associated with the available surface water quality data makes interpretation difficult. Some broad statements on surface water quality have been formulated.

To quantify the amount of ground water recharge that could be expected within river basins situated in the study area, streamflow hydrograph records were examined for the Terra Nova River and Middle Brook. Using the mean monthly flow data, mean ground water recharge values on the drainage basin of 382 and 313 mm (15.0 and 12.3 in) were calculated for the Terra Nova River and Middle Brook Basins respectively. However, due to the large percentage of surface water bodies on the two drainage basins, minimum recharge values of 184 and 215 mm (7.2 and 8.5 in) for the Terra Nova River and Middle Brook Basins respectively should be assumed. The amount of available ground water recharge certainly far exceeds the amount of ground water utilized in either basin.

Well construction practices, including the siting of wells, is probably the largest contributing factor to ground water contamination within the Bonavista Bay area. The frequency of septic effluent and road salt contamination problems is directly related to well construction. The amount of casing being driven into the bedrock is in most cases not sufficient. Usually less than 3 m (10 ft) and often less than 1.5 m (5 ft) of casing is installed into the uppermost bedrock surface; this surface can frequently be fractured to greater depths. Contaminants, if present, could be expected to move readily through these fractures into the well.

Potential does exist for substantially increasing the yield of drilled wells in bedrock aquifers and especially in surficial aquifers. Such yields can only be obtained if proper hydrogeological practices are utilized. The under utilization of surficial and bedrock aquifers can be attributed to improper well location and the lack of supervision associated with well drilling, development and testing.

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APPENDIX "A"

SURFICIAL DRILLED WELL RECORDS *

* The data presented is taken directly from the drillers' well records; no attempt was made to interpret or modify the data.

WATER WELL RECORD SUMMARY

APPENDIX "A"

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Carmanville	1	Town Council	11 73	02	26	6	26		60		0-26 overburden
Terra Nova	2	John Barrett	06 77	01	55	6	51		10	DO	0-55 sand and boulders
Terra Nova	3	Lloyd Scott	06 77	01	56	6	56		35	DO	0-56 sand
Terra Nova	4	Bill Holloway	06 77	01	30	6	30		10	DO	0-30 sand
Terra Nova	5	Wilford Faltham	06 77	01	25	6	22	10	35	DO	0-25 sand
Terra Nova	6	C.N.R.	06 77	01	68	6	66	14	40	IN	0-68 sand and boulders
Terra Nova	7	A.G. Freeman	06 77	01	40	6	37	20	12	DO	0-40 sand and boulders
Terra Nova	8	David Holliway	06 77	01	50	6	44	14	25	DO	0-50 sand and boulders
Terra Nova	9	G. Guzzwell	12 72	05	40		40				
Terra Nova	10	Mount Carmel Orphanage	03 78	01	60	6	60		35		0-60 gravel, sand and boulders

APPENDIX "B"

BEDROCK DRILLED WELL RECORDS *

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* The data presented is taken directly from the drillers' well records; no attempt was made to interpret or modify the data.

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Amherst Cove	1	D.M.A.H.	10 76	01	115	6	27			MU	
Amherst Cove Lower	2	D.M.A.H.		01	300		17	0	2.75	MU	0-3 topsoil 3-300 slate
Amherst Cove Lower	3	Water Services	12 77	01	300	6	17	0	1.75	MU	0-2 topsoil 2-300 siltstone
Amherst Cove Middle	4	D.M.A.H.		01	22.5	6	22	0	7	MU	0-18 gravel 18-175 siltstone 175-225 sandstone
Amherst Cove Middle	5	Water Services	12 77	01	210	6	22	0	7	MU	0-14 gravel 14-170 shale 170-210 sandstone
Amherst Cove Upper	6	D.M.A.H.	11 77	01	190	6	11		90	MU	0-4 gravel 4-130 siltstone 130-190 sandstone
Amherst Cove Upper	7	Water Services	12 77	01	190	6	10		90	MU	0-4 gravel. 4-190 slate, shale sandstone
Amherst Cove Upper	8	Calvin Skiffington		05	90		10				
Barr'd Islands	9	Water Supply Committee	03 69	02	83	6	7		2-3		
Barr'd Island	10	Water Supply Committee	11 68	02	323		9		5-6	DO	
Barr'd Island	11	Water Supply Committee	11 68	02	443	6	12		2-3		
Barr'd Islands	12		11 68	02	203		10				
Barr'd Islands	13	Water Supply Committee	11 68	02	203	6	7		2-3	DO	
Barr'd Islands	14	Water Supply Committee	11 68	02	158	6			1-2		
Barr'd Islands	15	Water Supply Committee	02 68	02	188	6	5				
Barr'd Islands	16		11 68	02	128		10				
Birchy Cove	17	D.M.A.H.	10 76	01	55	6	35		20	MU	
Bishops Harbour	18				200			17	4		
Bishops Harbour	19	D.M.A.H.	06 75	01	200	6			[illegible].5	MU	0-13 overburden
Bishops Harbour	20	D.M.A.H.	06 75	01	200	6			3	MU	0-22 overburden
Bishops Harbour	21	D.M.A.H.			160	6		15	2		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Bishops Harbour	22	D.M.A.H.	06 75	01	240	6			1	MU	0-13 overburden
Bloomfield	23	Pentacostal Church	09 78	01	125	6	11		.75		0-2 topsoil 2-125 conglomerate
Bloomfield	24	Thermo Seal Limited	11 80	04	300		23		.5		
Bloomfield	25	Bill Burry	09 80	04			22		1.5		
Bloomfield	26	Robert Peddle	08 79	04	60		44		20		
Bloomfield	27	D.M.A.H.	09 75	01	270		34	5	3		
Bloomfield	28	D.M.A.H.	09 85	01	220	6		1		MU	0-34 overburden
Bloomfield	29	Mr. Barbour	08 76	08	94		16	16		4	
Bloomfield	30	Charles Loveless	07 76	08	86		12	9		2.5	
Bloomfield	31	Whit Holliway	05 76	08	70	6		5		7	
Bloomfield	32	Annabell Peddle	05 77	05	150		17			2	
Bloomfield	33	W. Miday	07 72	03	70	6	15			4	
Bloomfield	34	Claude Parsons	04 72	03	87	6	22	8		7	
Bloomfield	35	Weldon Keats	09 73	03	100		33	8			
Bloomfield	36	Claude Parsons	09 73	05	36		36				
Bonavista	37	Grace Rolls	11 70	08	35		12			DO	
Bonavista	38	Roy Carpenter	11 70	08	42		21		5	DO	
Bonavista	39	Joseph Tilley	12 70	08	32		20			DO	
Bonavista	40	George Jine	01 71	08	55		21			DO	
Bonavista	41	A.G. Swyers	60		120					DO	
Bonavista	42	J.T. Swyers Co. Ltd.	62		350					IN	
Bonavista	43	H.T. Durdle	64		160					DO	
Bonavista	44	United Church	59		180					DO	
Bonavista	45	Dept. of Fisheries	05 75	02	255		10		5	MU	
Bonavista	46	Dept. of Fisheries	75	02	335		18		5	MU	0-18 18-335
Bonavista	47	Goerge Hadder	03 69	02	60	5	10		2	DO	0-10 gravel 10-60

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date mo/yr	Driller	Depth ft	Casing		Static Water Level ft	Yield gpm	Water Use	Lithology
						Dia. in	Lgth. ft				
Bonavista	48	Garfield & Tremblett	03 69	02	50		12.5		4	DO	0-12 gravel & boulders
Bonavista	49	Max Durdle		08	50		20			DO	
Bonavista	50	Harry Whiffen	03 69	02	50	5	15		7	DO	gravel & boulders
Bonavista	51	Roy Tremblett	05 72	05	65		14				
Bonavista	52	H.T. Durdle	07 63		130		17		2		
Bonavista	53	Gus Ford	07 77	05	70		15		5		
Bonavista	54	Lydia Billard	05 72	05	170		22				
Bonavista	55	Roy Butter	07 79	01	300	6	30			DO	0-27 sand & gravel 27-300 siltstone
Bonavista	56	George Hampton	06 78		65	6	11		3	MU	0-9 sand & gravel 9-65 granite
Brooklyn	57	Joshua Butt	02 80	04	180		52		3		
Brooklyn	58	Calvin Palmer	09 80	04	100		20		2.5		
Brooklyn	59	Joe A. LeBlanc	11 80	04	100		20		3		
Brooklyn	60	Mary Butler	05 80	01	125	6	22		.25	DO	0-10 gravel 10-95 sandstone 95-125 granite
Brooklyn	61	D.M.A.H.	09 75	01	200		22	8	4.5	MU	0-22 overburden
Brooklyn	62	Fred Pye	10 76	01	80	6			3	DO	0-6 overburden
Brooklyn	63	D.M.A.H.	76		78	6					
Brooklyn	64	A. Norman	11 76		50	6			4	DO	0-7 overburden
Bunyan's Cove	65	Welbert Oleford	11 79	04	150		20		1		
Bunyan's Cove	66	D.M.A.H.	09 75	01	79	6	22	10	20	MU	0-22 overburden
Bunyan's Cove	67	D.M.A.H.	09 75	01	200	6	13	18	.5	MU	0-13 overburden
Bunyan's Cove	68	D.M.A.H.	10 76	01	200				1.5	MU	0-22 overburden
Bunyan's Cove	69	Integrated School Board	08 72	03	121	6	23	10	28		
Burgoynes Cove	70	D.M.A.H.	08 75	01	300	6			2.5	MU	0-15 15-300
Burgoynes Cove	71	Clarenville Int. School Board	11 75	08	114		15		2.5		
Burgoynes Cove	72	D.M.A.H. M. Sceviour	10 76	01	200		22		1.5		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date mo/yr	Driller	Depth ft	Casing Dia. in	Casing Lgth. ft	Static Water Level ft	Yield gpm	Water Use	Lithology
Burgoynes Cove	73	D.M.A.H.	10 75	01	200		6		4	MU	0-21.5 21.5-200
Burnside	74	D. Ralph	08 79	04	130		11		.5		
Burnside	75	F. Oldfred	06 78	01	125	6	8		.5	DO	0-1 broken rock 1-125 shale
Burnside	76	A. Lane	08 79	04	125		10		.75		
Burnside	77	R. Humphis	08 79	04	140		10		1		
Burnside	78	M. Nurse	08 79	04	170		10		2		
Burnside	79	M. Oldford	06 80	04	140		8		.5		
Burnside	80	D. Bowering	06 70	05	140		11		2		
Cannings Cove	81	D.M.A.H.			62	6	12	11	15		
Cannings Cove	82	D.M.A.H.	03 73		90		16				
Cannings Cove	83	D.M.A.H.		08	169				15.5		redrilled from 90 to 169 ft.
Cannings Cove	84	School Board			90		12		10-15	MU	0-12 overburden
Cannings Cove	85	D.M.A.H.	04 72		100		21				
Cannings Cove	86	D.M.A.H.		08	175			16	15		redrilled from 105 to 175 ft.
Cannings Cove	87	School			95						0-18 overburden
Cannings Cove	88	Ambros Chatman			64	6	8		25		
Cannings Cove	89				168	6	16	11.5	15		
Cannings Cove	90				100	6	20		2		0-21 overburden
Cannings Cove	91	Abe Simmons			118				20		
Cannings Cove	92			02	273			30			0-15 overburden
Cannings Cove	93				277						0-26 overburden
Cannings Cove	94	Warrick Penny									
Cape Freels	95		09 64	02	230						0-3 3-230
Cape Freels	96	D.M.A.H.	09 64		220						0-52 52-220
Cape Freels	97	D.M.A.H.	09 64		240						0-55 55-240
Carmanville	98	Nfld. Light & Power	11 73	02	83	6	15		3		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Carmanville	99	Dept. of Public Works	04 72	02	323	6	8		2.5		
Carmanville	100		07 68	02	240		15		3		
Carmanville	101		12 69	02	152				5		
Carmanville	102	Nolan, White & Associates	05 76	01	200	6			10	DO	0-17 17-200
Carmanville	103	Nolan, White & Associates	05 76	01	252	6			10	DO	0-19 19-252
Carmanville	104		08 68	02	105		28				0-22 22-105
Carmanville	105		08 68	02	210		22				
Carmanville	106		08 68	02	245		6				
Carmanville	107		09 68	02	310		22				
Carmanville	108	G.M. Parsons	05 78	01	45	6	10		20		0-3 gravel and bedrock 3-45 granite
Carmanville	109	School Board	04 78	01	310	6	9		4		0-6 gravel 6-156 granite 156-310 shale
Carmanville	110	J. Butt	05 78	01	200	6	7		15		0-5 gravel 5-200 granite
Carmanville	111	H. Butler	05 78	01	125	6	14		.75		0-12 gravel and boulders 12-125 sandstone
Carmanville	112	J. Tulk	05 78	01	165	6	7		2		0-5 gravel 5-25 granite 25-165 sandstone
Carmanville	113	R. Tulk	06 79	01	65	6	7		1.5	DO	0-5 gravel, broken rock 5-65 granite
Carmanville	114	R. Collins	06 79	01	230	6	11		.25	DO	0-8 gravel and boulders 8-158 granite 158-230 sandstone
Catalina	115	School	08 73	02	188	6	11		2		
Catalina	116	Fed. Bldg.	02 69	02	78	5	12		8	MU	
Catalina	117	S. Heale	10 76	01	35	6			6	DO	0-6 6-35
Catalina	118	H. Mifflin	11 62	05	160		12				
Catalina	119	S. Gulliage	08 63	05	120		12				
Catalina	120	H. Mifflin	10 62	05	200		6		3		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Champney's	121	H. Randell	70		76		9				
Champney's	122	D.M.A.H.	05 70		126		14		2.5	MU	
Champney's	123	D.M.A.H.	05 70		106	6	11		6	MU	
Champney's Arm	124		03 74	08	70		15				
Champney's Arm	125	D.M.A.H.		01	56	6			8		
Champney's West	126	D.M.A.H.	06 75	01	300	6			1.75	MU	0-10 10-300
Champney's West	127	Nfld. Light & Power	03 76	01	76	6			3	IN	0-8 8-76
Champney's West	128	D.M.A.H.	04 70		105				9		0-13 13-105
Champney's West	129	D.M.A.H.	04 70		126				3		0-12 12-126
Champney's West	130	C. Verge	06 77	01	106	6	12		.25		0-6 6-106 granite
Champney's West	131	O. Rex	09 77	01	125	6	14		.25	DO	0-10 gravel 10-125 granite
Charleston	132		10 71		115				3	MU	0-21 21-115
Charleston	133		08 71		90				2	MU	0-20 20-90
Charleston	134	Dept. of Forestry	09 73	08	60		18			MU	
Charleston	135	Com. & Social Development	08 71	08	78		18			MU	
Charleston	136	E. Russell	12 72	08	53					MU	
Charleston	137	Arctic Fisheries Ltd	09 75	01	300	6			3	IN	0-15 15-300
Charleston	138	D.M.A.H.	09 75	01	220		22.5		1	MU	
Charleston	139		03 78	01	200	6	22		2		0-15 gravel and broken rock 15-200 sandstone
Charleston	140	R. Fry	07 77	01	42	6	9		1.5	DO	0-3 boulders 3-42 slate
Charleston	141	D.M.A.H.	04 78	01	230	6			6		
Charleston	142	C. Pike	04 79	04	140		18				
Charleston	143	R. Fry	04 79	04	140		22		7		
Charleston	144	C. Pike	04 79	04	140		18		10	overflowing	

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Charlottetown	145	Terra Nova Construction	09 75	01	200	6			1	DO	0-21 overburden
Clarkes Head	146	Terra Nova Int. School Board	02 71	02	250	6	44		nil		
Clarkes Head	147	D. Francis	06 79	01	100	6	7		.25	DO	0-3 gravel 3-100 sandstone
Clarkes Head	148	R. Cillingham	07 79	01	125	6	7		.5	DO	0-2 gravel 2-125 sandstone
Culls Harbour	149	D. Mackey	04 78	01	85	6	9		.25		0-3 gravel 3-85 sandstone
Culls Harbour	150	D.M.A.H.	02 68	05	200		4		1.5		0-6 overburden
Culls Harbour	151	Frank Kelly	05 77	01	55	6		2	.5	DO	0-2 overburden 2-55 slate
Dark Cove	152	Nlfd. Light & Power	03 76	02	165		9		1.5		
Dark Cove	153	Sunset Farm A. Collins	08 78	04	280				1.5		
Davidsville	154	D.M.A.H.			101	6			1		
Davidsville	155	D.M.A.H.			101	6			2-3		0-10 10-101
Davidsville	156	D.M.A.H.		02	100	6			2-3		0-12 12-100
Davidsville	157	D.M.A.H.			108.5	6			1		
Davidsville	158	D.M.A.H.	03 74	02	98	6	10		2-3		0-10 10-98
Davidsville	159	L.Simmons	07 79	01	85	6	9		6	DO	0-5 gravel 5-25 shale 25-85 sandstone
Deep Bay	160		06 69	02	98	6	5				
Dunfield	161	D.M.A.H. J. Marshall	08 75	01	77	6	13		5.5	MU	0-13 13-77
Dunfield	162	D.M.A.H.	12 77	01	250	6	17		2	MU	0-12 gravel 12-250 slate
Dunfield	163	D.M.A.H.	06 78	01	102	6			7	MU	
Dunfield	164	Gov't well	07 79	01	200	6	12		12	MU	0-8 gravel 8-200 siltstone
Duntara	165	J. Weeks	06 73	08	35		10			DO	
Duntara	166	A. Devereaux	08 76	05	45		20		2		
Duntara	167	K. Nolan	08 76	05	50		22		3		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Elliston	168	C. Porter	06 70	08	68		17			DO	
Elliston	169	Dept. of Public Works	12 76	08	115		24			MU	
Elliston	170	D.M.A.H.			170	6			2.5	MU	
Elliston	171	Wm. Faulkner	06 77	01	114	6	12		.5	DO	0-4 boulders and sand
Elliston	172	C. Tilley Ltd	11 62	05	170	6	10				
Elliston	173	I. Perce	08 76	06	110 or 140		31		.5		
Elliston	174	P. Tucker	07 77	05	70		10		1.5		
Elliston	175	Town Council	11 74	05	220		8		8		
Elliston	176	Town Council	11 74	05	165		25		6		
Elliston	177	C. Tilley		05	145	6	14		2		
Elliston	178	Town Council	11 74	05	250		12		5		
Elliston	179	C. Tilley Ltd	11 62	06	175	6	13		4		
Elliston	180	Town Council	11 75	05	175		17		15		
Elliston	181	Town Council	11 74	05	175		25		10		
Elliston	182	Nfld. & Lab Power Comm.	05 72	05	244				10		
Elliston	183	J. Templeman	08 76	05	150		26		.75		
English Harbour	184	Wm. Ridgley	10 76	08	68		8		6		
English Harbour	185	Post Office	10 76	08	76		27				
English Harbour	186	S. Penny	10 69	03	90		17				
Federicton	187	Terra Nova Integrated School Board		02	113	6	15		2.50		
Federicton	188	R. Drummond	05 78	01	65	6	10		1	DO	0-5 gravel 5-65 sandstone
Federicton	189	D. Simms	06 79	01	65	6	6		1	DO	0-2 broken rock 2-65 granite
Federicton	190	Newton Wheaton	07 79	01	65	6	8		1	DO	0-4 gravel 4-65 granite
Federicton	191	David Wheaton	07 79	01	85	6	8		.50	DO	0-3 broken rock 3-85 granite

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Federicton	192	J. Brown	07 79	01	85	6	7		.5	DO	0-4 gravel 4-85 granite
Federicton	193	Gilmore Hancott	97 79	01	55	6	7		2	DO	0-2 gravel 2-55 granite
Federicton	194	Andrew Butt	06 79	01	65	6	12		35	DO	0-6 gravel 6-65
Federicton	195	Brian Wheaton		01	85	6	14		1	DO	0-10 gravel 10-85 granite
Federicton	196	Frank Wheaton	06 79	01	165	6	12		.5	DO	0-5 broken rock 5-165 granite
Federicton	197	Eugene Wheaton	06 79	01	45	6	27		2.5	DO	0-25 gravel 25-45 shale
Federicton	198	Hayward Hancott	06 79	01	100	6	11		3	DO	0-1 sod 1-100 sandstone
Federicton	199	Woodrow Wheaton	06 79	01	65	6	6		6	DO	0-2 gravel 2-65 sandstone
Federicton	200	Gilbert Hodder	06 79	01	150	6	8		.5	DO	0-3 gravel 3-150 sandstone
Federicton	201	Lewis Wheaton	06 79	01	105	6	10		.5	DO	0-5 gravel 5-105 granite
Fogo	202	Dept. of Public Works	06 69	02	113	6	5		10-12		
Fogo	203	Town Council	03 69	02	113	6	6		3-4		
Fogo	204	Town Council	04 69	02	188	6	7		3-4		
Fogo	205	Town Council	05 69	02	188	6	4		2		
Fogo	206	Benson Hewitt	04 74	02	70		5		1	DO	
Fogo	207	Raymond Pope	03 76	02	70	6	5			DO	
Fogo	208	Town Council	03 69	02	158	6	5		2-3	DO	
Fogo	209	Town Council	04 69	02	158	6	5		4-5	DO	
Fogo	210	Town Council	06 69	02	158	6	9		1-2		
Fogo	211	Terra Nova Integrated School Board		02	248		12		2-3		
Fogo	212	Dept. of Public Works	06 69	02	383	6	12		5-6		
Fogo	213	Town Council	05 69	02	233		4		1-2	DO	
Fogo	214	Town Council	05 69	02	308		4		nil		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Fogo	215	Town Council	05 69	02	243		5		2-3		
Fogo	216	Town Council	05 69	02	128		6		2-3	DO	
Fogo	217	Town Council	05 69	02	128	6	6		2-3	DO	
Fogo	218	Grey Bros. Ltd	03 76	02	140	6	20		2		
Fogo	219	L. Payne	04 76	02	83		5			DO	
Fogo	220	G. McKenna	03 76	02	35	6	5		1.5	DO	
Fogo	221	Fogo Hospital			177	6					
Fogo	222	Town Council	05 69	02	143	6	7		2-3	DO	
Fogo	223	Abel Freake	04 76	02	40		6			DO	
Fogo	224	Cyril Oake	04 76	02	60		5		.5	DO	
Fogo	225	Dept. of Comm. & Social Development	04 69	02	278	6	5				
Fogo	226	Cottage Hospital		09	203				12		
Fogo	227	Dept. of Public Works			200	6					
Fogo	228	Owen Conbden	10 76	05	70	6	6		.25		
Fogo	229	John Maunder	10 76	06	110	6	7		.5		
Fogo	230	Arron Jacobs	10 76	05	50	6	12		5		
Fogo	231	Fogo Island Motel	10 76	05	150		20		8.5		
Fogo	232	B. Walbourne	10 76	05	110	6	5		5		
Fogo	233	R. Oake	10 76	05	30		12		2		
Fogo	234	E. Walbourne	10 76	05	130	6	10		.25		
Fogo	235	Earne Coish	10 76	05	80		6				
Fogo	236	C. Walbourne	10 76	06	130	6	6				
Fogo	237	Imperial Oil	10 76	06	210-200		10		.5		
Gambo	238	C.N.R.	12 68	02	84				3.5		0-12 12-84
Gander Bay	239	Gander Bay School	12 68	02	170						
Gander Bay	240	Roy B. Record	12 72	02	380	6	15				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Gander Bay	241	Gander Bay High School	10 67	02	195		20			MU	
Gander Bay Road	242	R. Frew		02	143	6	54		1.5		
Gander Bay Road	243	M. Sullivan		02	350	6	31				
Gander Bay Road	244	Ron Noseworthy		02	95	6	27		3		
Gander Bay South	245	D.M.A.H.	10 74	02	233	6	12		4		
Gander Bay South	246	D.M.A.H.	10 74	02	210	6	9				
Gander Bay South	247	D.M.A.H.	10 74	02	170	6	34		2		
Gander Bay South	248	D.M.A.H.	10 74	02	120	6	10				
George's Brook	249	D.M.A.H. G. Ellis	10 74		325		27		.5		
Glovertown	250	Boyde Rowe	06 80	01	200	6	44		.25	DO	0-43 sand, gravel and boulders 43-200 sandstone
Glovertown	251	Manuel Davis	10 80	04	140		20				
Glovertown	252	J. Petten	06 80	01	45	6	10			DO	0-5 gravel 5-45 sandstone
Glovertown	253	Golden Eagle	02 69	02	252	6			6		0-104 overburden
Glovertown	254	Irving Oil	12 72	05	285	6	31		4.5		
Glovertown	255	Town Council	05 69	05	175		9				
Glovertown	256	Forbie Adams	09 76	05		6	62		4		
Goose Cove	257	John Fury Ltd	06 73	02	200		11		bad		
Goose Cove	258	Mountain View Farm	03 76	01	115	6			4	DO	0-14 14-115
Goose Cove	259	Martin Jeetican	07 79	01	203	6	20		.25	DO	0-17 sand & gravel 17-117 sandstone 117-157 shale 157-203 siltstone
Happy Adventure	260	L.S.Gettle	04 78	01	105	6	10		1.5	DO	0-2 gravel 2-45 shale 45-105 sandstone
Happy Adventure	261	L.S. Gettle	07 78	01	190	6	10		1	DO	0-2 gravel 2-45 shale 45-190 sandstone
Happy Adventure	262	L.F. Gettle	07 72	02	248		9		.5-1		
Harcourt	263	E. Walters	05 76	08	100		50		.5		
Island Harbour	264		03 76	02	100	6	5		nil		
Jameston	265	D.M.A.H.	09 75	01	200	6	21.5	36	5	MU	0-2.5 overburden

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Joe Batt's Arm	266	Improvement Committee	02 69	03	293	6	7		8-9		
Joe Batt's Arm	267		01 69	02	293	6	5		2-3		
Joe Batt's Arm	268	Improvement Committee	01 69	02	158	6			2-3		
Joe Batt's Arm	269	Fisherman's Union Trading		02	158		5		12-15		
Joe Batt's Arm	270	Improvement Committee	02 69	02	278	6			4-5		
Joe Batt's Arm	271	Improvement Committee	02 69	02	263	6	7		5-6		
Joe Batt's Arm	272	Improvement Committee	02 69	02	233	6	5		2-3		
Joe Batt's Arm	273	Improvement Committee	01 69	02	113	6	6		5-6		
Joe Batt's Arm	274	Improvement Committee	01 68	02	113	6	5		5-6	DO	
Joe Batt's Arm	275	Improvement Committee	01 69	02	113		5		5-6		
Joe Batt's Arm	276	Improvement Committee	01 69	02	173	6	6		2-3		
Joe Batt's Arm	277	Improvement Committee	02 69	02	173	6	5		7-8		
Joe Batt's Arm	278	Improvement Committee	02 69	02	158				3-4		
Joe Batt's Arm	279	Improvement Committee	02 69	02	308				10-12		
Joe Batt's Arm	280	Improvement Committee		02	188	6	5		5-6		
Joe Batt's Arm	281	Improvement Committee	01 69	02	128	6	5		2-3	DO	
Joe Batt's Arm	282		01 69	02	143	6			5-6		
Keels	283	G. Penney	06 73	08	75		10			DO	
Keels	284	K. Hobbs	06 73	08	52		4			DO	
Keels	285	H. Mesh	06 73	08	36		5			DO	
Kings Cove	286		08 69	02	158		14				
Kings Cove	287	R.C. School Board		02	338		11		8	MU	
Kings Cove	288	J. Keough	08 75	05	50		20		3		
Kings Cove	289	P. Mills	77	05	80		17				
Kings Cove	290	E. Unsex	12 80	04	160		22		1.5		
Kings Cove	291	R. Monks	12 80	04	240		19		1		
Ladle Cove	292	C. Banks	07 79	01	105	6	10		nil		0-8 gravel 8-105 shale

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Lethbridge	293	Phyllis Diamond	10 79	04	100		20			4	
Lethbridge	294	Herman Russel	10 79	04	126		40		7		
Lethbridge	295	Lou Halloway	02 80	04					3		
Lethbridge	296	F. Brown	09 80	04	140		22		1.5		
Lethbridge	297	E. Leayte	06 80	04	60		26		6.5		
Lethbridge	298	Dun Rovin Motel	06 78	01	170	6	31		3		0-28 sand & gravel 28-170 sandstone
Lethbridge	299	M. Tucker	06 78	01	65	6	21		4		0-18 sand & gravel 18-65 sandstone
Lethbridge	300	Eugene Hancock	06 78	01	100	6	10		.25	DO	
Lethbridge	301	Walter Young	02 76	08	80		35	16	3.5		
Lethbridge	302	Dept. Public Works	09 76	08	100		19				
Lethbridge	303	Seven Day Adventist Church	06 76	08	68		19	10	4		
Lethbridge	304	Pastor Gill			90			11	4		
Lethbridge	305	Ron Harris & D. Penny	06 76	08	70		11	8	2		
Lethbridge	306	Oliver Brown	05 76	08	104		21	18	3		
Lethbridge	307	Bill King	11 76	08	45		19	11	4		
Lethbridge	308	Weston Pitcher	06 75	08	300		43				
Lethbridge	309	Moses Lethbridge	02 75	08	90		13				
Lethbridge	310	Community	10 74	05	250		12		7		
Lethbridge	311	Community	10 74	05	115		25		10-12	DO	
Lethbridge	312	Community	10 75	05	130		25		8-10	DO	
Lethbridge	313	John Strowbridge								DO	
Lethbridge	314	Harvey Penny								DO	
Lethbridge	315	Christopher Smart	06 77		90	6	42 & 57				
Lethbridge	316	C.N.R.	06 72	03	88		38	4	6		
Lethbridge	317	Greetings Restuarant	04 72	03	145	6	52	6	4		
Lethbridge	318	Bulk Plant	08 73	03	134		66	18	2		
Lethbridge	319	Nfld. Farm Products Corp.	11 71	05	58		21		19		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Lethbridge	320	Nfld. Farm Products Corp.	11 71	05	258		33		4.5		
Lethbridge	321	Dept. of Highways	10 68	03	190	6	40	30	3		
Little Catalina	322	John Dalton	04 70	08	53		20			DO	
Little Catalina	323	Paul Brownlee	12 73	08	56		22			DO	
Little Catalina	324	A. Humby	07 77	05	50		7		3		
Little Seldom	325		06 69	02	173	6	6		5-6		
Lumsden	326	Town Council	09 69	02	270	6	24				
Lumsden	327	Dept. of Public Works	04 69	02	310	6			15		
Lumsden	328	U.C. Elementary School	06 69	02	78						
Maberly	329	Noah Caaull	07 70	08	56		11			DO	
Melrose	330	E. Lane	08 75	08			10				
Melrose	331	D.M.A.H.			205	6			1		
Melrose	332	D.M.A.H.			204	6			4		
Melrose	333	D.M.A.H. (J. Murray)			202				1		
Melrose	334	D.M.A.H. (R. Janes)			100				1		
Melrose	335	D.M.A.H. (J. Murray)			130	6			5		
Melrose	336	Town Council	05 74	05	130		15		10		
Melrose	337	Town Council	05 74	05	200		12		4		
Melrose	338	Town Council	05 74	05	200		12		1		
Melrose	339	Town Council	05 74	05	100		12		3		
Melrose	340	Town Council	05 74	05	200		22		1.5		
Melrose	341	T. Peters	09 79	04	140		21		6		
Melrose	342	C. Matthews	12 80	04	300		15		12		
Musgravetown	343	Healy Wiseman	08 78	01	135	6	75		.75	DO	0-70 sand & gravel boulder 70-135 granite
Musgravetown	344	G. Crewe	05 79	01	105	6	10		6	DO	0-5 gravel 5-105 sandstone
Musgravetown	345	Salvation Army	05 79	01	415	6	14		1.5	DO	0-11 gravel & broken rock 11-136 shale 136-415 sandstone

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Musgravetown	346	Larry Greening	07 79	04	30		5				
Musgravetown	347	Betcher Greening	07 79	04	30		5				
Musgravetown	348	Rick Greening	07 79		30		5		7		
Musgravetown	349	Rick Greening	07 79	04	90		15				
Musgravetown	350	Fred Greening	07 79	04	30		5				
Musgravetown	351	Bussy Dampier	10 79	04	120		21		1		
Musgravetown	352	Greening Poultry Farm	10 79	04	120		20		60		
Musgravetown	353	Integrated School Board	06 75	08	80	6	30	12	6		
Musgravetown	354	D.M.A.H.	06 76	08	109	6	13	22	2		
Musgravetown	355	D.M.A.H.	11 73	08	110		13				
Musgravetown	356	William Skiffington			110	6	11		4		
Musgravetown	357	High School	11 68	02	100	6			16		0-12 overburden
Musgravetown	358	Malcolm	12 68	02	53	6			12		0-16 overburden
Musgravetown	359	Dalman Chaffey	07 76	08	73		8	11	2.5		
Musgravetown	360	W. W. Young & Sons	09 75	08	142		11				
Musgravetown	361	Integrated School Board	12 75	08	94		10	9	6		
Musgravetown	362	Integrated School Board	12 75	08	162		14	8	8		
Musgravetown	363	Malcolm Brown	07 75	08	120		10				
Musgravetown	364	Cerick Mathews	10 73	08	130		8				
Musgravetown	365	Wagon Wheel Country Club	05 74	08	56	6 8	7 4				
Musgravetown	366	Edgar Penny	11 73		174		12				
Musgravetown	367	Dr. Barbour		05	110		22				
Musgravetown	368	Philip Patey	12 72	05	100		20				
Musgravetown	369	Brian Carrin	06 77	05	70		15		20		
Musgravetown	370	Port Bloomfield Winter Brook	05 80	04	120		18		45		
Musgravetown	371	Oliver Greening	11 80	04	80		33		30		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date mo/yr	Driller	Depth ft	Casing Dia. in	Casing Lgth. ft	Static Water Level ft	Yield gpm	Water Use	Lithology
Musgravetown	372	Tobias Matthews	06 80	04	100		24		5		
Musgravetown	373	Pearce Skiffington	06 80	04	100		20		1		
Musgravetown	374	Mrs. J. Greening	07 79	04	180		20				
Musgrave Harbour	375		05 67	02	130		16				
Musgrave Harbour	376		05 71	02	455		19				
Musgrave Harbour	377		07 68	02	305		21		15	MU	0-21 sand & gravel 21-305
Musgrave Harbour	378		05 67	02	205		24		15		0-24 gravel 24-205 hard rock
Musgrave Harbour	379		11 69	02	49						
Musgrave Harbour	380		11 69	02	293	6	11.5		9-11	DO	
Musgrave Harbour	381		07 68	02	270	5	22				
Musgrave Harbour	382		07 71	02	270		8				
New Bonaventure	383	D.M.A.H.	08 75	01	200	6	16		.5	MU	0-15 15-200
New Bonaventure	384	Clarenville Integrated School Board	11 75		90	6	13		2.5	DO	
Newman's Cove	385	Newman's Cove Water Committee	10 79	04	39		39		20		
Newman's Cove	386	D.M.A.H.		05	56	6			23	MU	
Newman's Cove	387	D.M.A.H.	05 74	05	50		33			MU	
Noggin Cove	388	Lester Sheppard	06 79	01	135	6	10		.5	DO	
Noggin Cove	389	W. Parson	06 79	01	85	6	9		.5	DO	0-7 gravel and boulders 7-85 granite
Noggin Cove	390	C. Hodder	06 79	01	100	6	9		.5	DO	0-5 broken rock 5-100 sandstone
Noggin Cove	391	Nfld. & Lab Housing Corp	07 79	01	250	6	36		.5		0-30 gravel 30-250 sandstone
Noggin Cove	392	Water Improvement Committee	05 78	01	65	6	3		.5		0-65 granite
Noggin Cove	393	Raymond Gillingham	05 78	01	150	6	25		.75		0-20 gravel 20-24 broken rock 24-150 very hard rock

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Noggin Cove	394	John Parsons	05 78	01	155	6	4		1.25		0-2 gravel 2-55 granite 55-155 sandstone
Old Bonaventure	395	D.M.A.H.	12 77	01	250	6	11		.5		0-3 topsoil 3-250 slate
Open Hall	396	Ronald Fitzgerald	02 75	08	126		13			DO	
Open Hall	397	D.M.A.H.	09 75	01	220	6	15.5		.5	MU	
Open Hall	398	D.M.A.H.	09 75	01	140	6	14.5		.5	MU	
Plate Cove	399	B. Hide	12 80	04	100		30		2		
Plate Cove	400	A. Tracey	09 79	04	220		21		1.5		
Plate Cove	401	T. Keys	09 79	04	240		22		2		
Plate Cove (East)	402	R.C. School Board (Gander)	11 72	02	188	6	36		6	MU	
Plate Cove (East)	403	Nolan, White & Associates Limited	09 77	01	200	6	12		.5		0-6 gravel & boulders 6-200 sandstone
Plate Cove (East)	404	Nolan, White & Associates Limited	09 77	01	200	6	21		2		0-16 sand & boulders 16-136 sandstone 136-200 granite
Plate Cove (East)	405	Nolan, White & Associates	09 77	01	200	6	22		1.25		0-18 sand & gravel 18-200 sandstone
Plate Cove (West)	406	Michael Furlong		02	188		12			DO	
Plate Cove (West)	407	Town Council	08 76	05	260		34		2.5		
Plate Cove (West)	408	A. Welsh	08 76	05	230		38		5		
Plate Cove (West)	409	Town Council	04 77	05	370		20		2		
Plate Cove (West)	410	Viking Construction	04 77	05	470		45		8		
Plate Cove (West)	411	Nolan, White & Associates	10 77	01	200	6	12		.5		0-8 sand & gravel 8-200 sandstone
Plate Cove (West)	412	Nolan, White & Associates	09 77	01	200	6	14		2.5		0-10 sand & gravel 10-200 sandstone
Port Blandford	413		03 76	02	217						0-160 overburden
Port Blandford	414				200	6	10 - 87		2.5		
Portland	415	E. Ash	07 78	01	55	6	14		1.5	DO	0-10 gravel 10-55 shale
Portland	416	E. Curtis	06 80	04	100		11		60		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Portland	417	Calvin Ash	03 76	08	86		12	12	2		
Portland	418	Ed Ash	10 76	01	69	6			3	DO	0-27 overburden
Port Rexton	419	Town Council	07 75	01	200	6			.5	MU	0-22 22-200
Port Rexton	420	Town Council	07 75	01	200	6			2	MU	0-22 22-200
Port Rexton	421	School	11 76	01	500	6			.5	IN	0-205 205-500
Port Rexton	422	Town Council	07 75	01	185				2.5	MU	0-12.5 12.5-185
Port Rexton	423	Frank Porter Sr.	09 72	08	85		10				
Port Rexton	424	F. Simms	07 72	08	86		14				
Port Rexton	425	J. King	09 73	08	65		10				
Port Rexton	426	F. Shelly	09 72	08	61		22				
Port Rexton	427	F. Porter Sr	09 72	08	40		15				
Port Rexton	428	Community Council	10 71	08	145		15				
Port Rexton	429	A. Butler	08 72	08	95		16				
Port Rexton	430	Community Council	06 74	08	175		9				
Port Rexton	431	R. Cook	08 72	08	64		18				
Port Rexton	432	Community Council	06 74	08	162		41				
Port Rexton	433	E. Cook	04 70	08	35		11				
Port Rexton	434	Community Council	10 70		120		16				
Port Rexton	435	Community Council	10 70		185		22				
Port Rexton	436	F. Ivany	06 77	01	112	6	22		1	DO	0-12 12-112 granite
Port Rexton	437	Town Council (C. Piercy)	10 69	03	190	6	21		6		
Port Rexton	438	P. Bannister	10 69	03	90	6	19		3		
Port Rexton	439	Town Council	08 77	05	90		20		8		
Port Rexton	440	Saunders & Howell	04 74	03	260		22				
Port Rexton	441	Elden Bannister	09 70	04	220		23		1		
Port Rexton	442	Gordon Hoaky	08 80	04	160		22		4		
Princeton	443	Dept. Comm. & Soc. Dev.	01 72	08	78		11		2.5	MU	

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Princeton	444	Dept. Comm. & Soc. Dev.	03 72	08	90		15		2	MU	
Princeton	445	Abraham Fry	08 76	05	260		14		.5		
Princeton	446	J. Prince		05	70		34				
Princeton	447	A. Quinton	08 76	05	260		14		3		
Princeton	448	Village Store	03 78	01	200	6	42		.25		0-30 sand & gravel 30-105 shale 105-200 granite
Red Cliffe	449	J. Oldford	11 78	01	45	6	11		15	DO	0-5 gravel 5-45 shale
Salvage	450	Well Committee	07 71	02	248	6	8		nil		
Salvage	451	Town Council	06 75	01	250	6			1.5	MU	0-29 overburden
Salvage	452	Town Council	05 71	02		6			2-3		
Salvage	453	Town Council	07 71	02	173	6	7		1-2	MU	
Salvage	454	D.M.A.H.	11 69	02	113	6	10		4-5	DO	
Salvage	455	James Morgan	12 76	01	55	6			2	DO	0-15
Salvage	456	Well Committee	07 71	02	143	6	8		2		
Salvage	457	D.M.A.H.			115	6		2	10		
Salvage	458	Town Council			120						
Sandringham	459	D.M.A.H.		05	125		60				
Seldom	460		06 69	02	248	6	5		2-3		
Seldom	461	Fish Plant	08 69	02	263					IN	
Seldom	462	Dept. Comm. & Soc. Dev.	03 68	02	263	6	5		8-10		
Seldom	463		06 69	02	218	6	7		10-12		
Southern Bay	464	Mr. Quinton	06 76	08	76		11		1.5	DO	
Southern Bay	465	L. Quinton	11 76	01	50	6			2	DO	0-8 8-50
Southern Bay	466	James Quinton	07 77	01	120	6	11		3	DO	shale
Spillar's Cove	467	J. Steak	07 77	05	150		18				
Square Pond	468		07 61	02	108						
Stag Harbour	469	Stag Harbour Citizen's Committee		02	323		9				
Stag Harbour	470	Stag Harbour Citizen's Committee	10 68	02	323		7				
Stag Harbour	471	Stag Harbour Citizen's Committee	10 68	02	277		7		3-4	DO	

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Stag Harbour	472	E. Collins	04 76	02	100		6			DO	
Stag Harbour	473	Stag Harbour Citizen's Committee	10 68	02	315	6	12		5		
Stag Harbour	474	Stag Harbour Citizen's Committee	10 68	02	248		9		4-5		
Stag Harbour	475	Stag Harbour Citizen's Committee	10 68	02	308		7				
Stag Harbour	476	Wallis, Collins & Howard Sheppard	03 76	02	50	6	5		.5	DO	
Stock Cove	477	D.M.A.H.	10 76	01	300	6	28		.75	MU	0-28 28-300
Stock Cove	478	D.M.A.H.			325				nil		
Stock Cove	479	Gardner & Pitcher	01 75	08	160		37			DO	
Stock Cove	480	Mr. Parker	09 75	08	104		7.5			DO	
Summerville	481	Dept. Comm. & Soc. Dev.	12 71	08	30		11			MU	
Summerville	482	Dept. Comm. & Soc. Dev.	10 72	08	100		12			MU	
Summerville	483	Dept. Comm. & Soc. Dev.	11 71	08	165		17			MU	
Summerville	484	Dept. Comm. & Soc. Dev.	12 71	08	103		11		1.5	MU	
Summerville	485	D.M.A.H.	09 75	01	200		22		.75	MU	
Summerville	486	D.M.A.H.	09 75	01	220	6	15		.5	MU	
Summerville	487	D.M.A.H.	08 75	01	200	6	15		.75	MU	
Summerville	488	Horseshoe Lounge	08 76	05	140		66		2.5		
Summerville	489	A. Brennan	04 80	01	150	6	10		.5	DO	0-2 gravel 2-150 sandstone
Summerville	490	R.G. Knight	11 79	01	145	6	10		.5	DO	0-3 gravel 3-145 granite
Summerville	491	D.M.A.H.	04 78	01	300	6			2		
Summerville	492	D.M.A.H.	03 78	01	200	6	11		1	MU	0-6 sand and broken rock 6-200 sandstone
Summerville	493	D.M.A.H.	03 78	01	250	6			.75		deepened well from 200 feet to 250 feet (no increase in flow)

WATER WELL RECORD SUMMARY

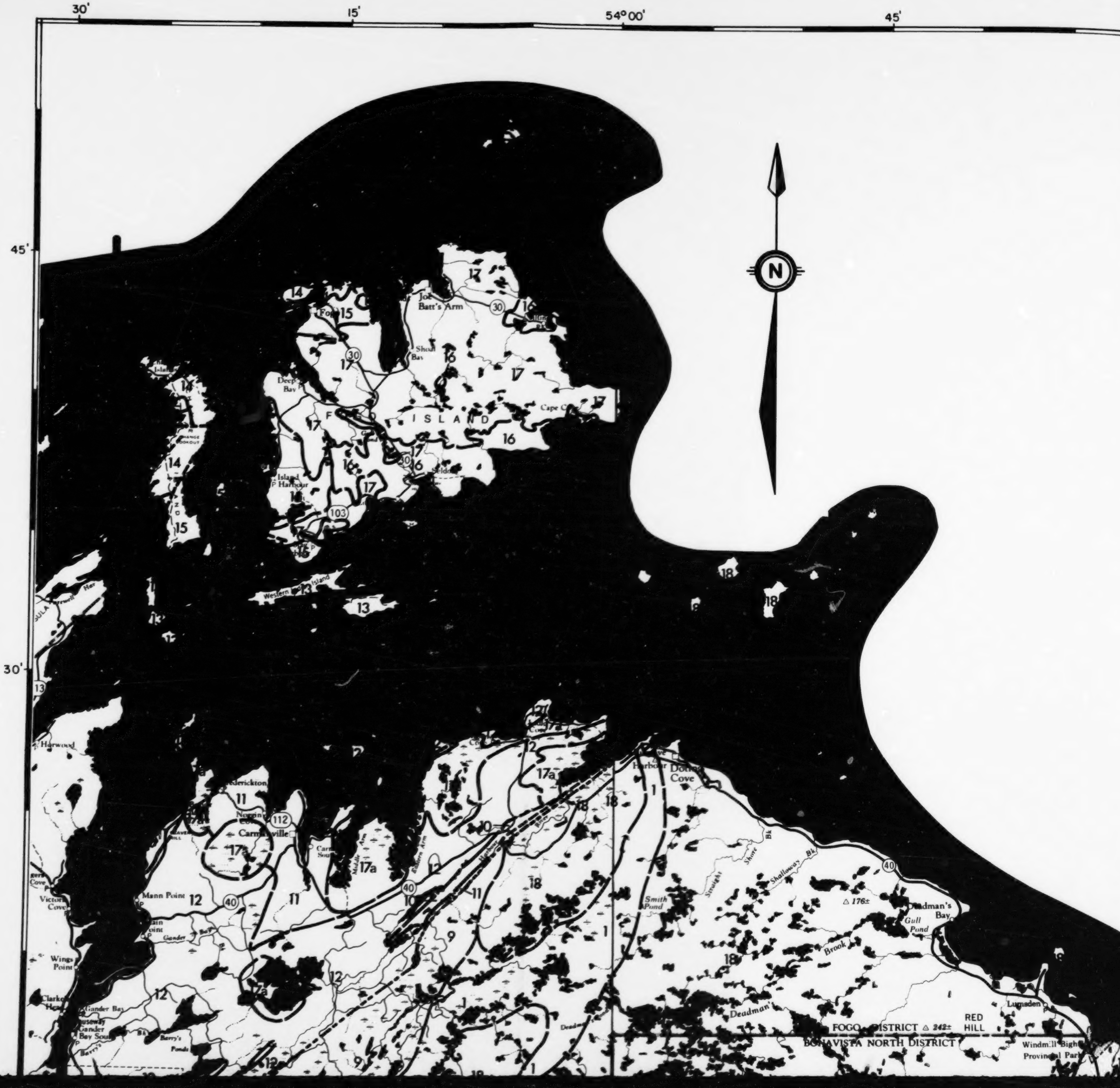
Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Sweet Bay	494	D.M.A.H	10 76	01	300	6	22		1.75	MU	
Sweet Bay	495	T. Dooley	02 79	01	85	6	28		3	DO	0-20 gravel 20-85 shale
Sweet Bay	496	R. Walker	07 79	01	85	6	11		.5	DO	0-9 broken rock 9-85 siltstone
Tickle Cove	497	D.M.A.H.	01 74	08	128		10		8	MU	
Tickle Cove	498	W. Lane	10 76	01	50	6			1.5	DO	0-7 7-50
Tickle Cove	499	D.M.A.H.	08 75	01	200	6	15		10	MU	0-15 15-200
Tickle Cove	500	D.M.A.H.	01 74	08	128		6			MU	
Tickle Cove	501	D.M.A.H.			124.5	8 & 6			5	MU	
Tickle Cove	502	A. Legge	09 80	04	140		10		1		
Tickle Cove	503	P. Lane	08 77	01	140	6	9		1	DO	0-3 gravel 3-140 mudstone
Tickle Cove	504	D. Connors	08 77	01	143	6	18		.5	DO	0-11 pug 11-143 mudstone
Tilting	505	Water Supply Committee	12 68	02	113	6	6				
Tilting	506		11 68	02	113	6	6		5-6	DO	
Tilting	507	Water Supply Committee	11 68	02	113	6	6		4-5		
Tilting	508	Water Supply Committee	12 68	02	143	6	5				
Tilting	509	Water Supply Committee	12 68	02	143	6				DO	
Tilting	510		11 69	02	54				5		0-15 15-54
Tilting	511		12 68	02	188	6					
Tilting	512	D.M.A.H.	12 68	02	98	6	5		5-6	DO	
Tilting	513	D.M.A.H.	01 69	02	128	6	6		2-3	DO	
Traytown	514	T. Wells	06 80	01	200	6	10		.25	DO	0-5 gravel 5-200 sandstone
Traytown	515		11 66	02	38						0-10 overburden
Traytown	516	D.M.A.H.	11 67	05	140		14				
Traytown	517	D.M.A.H.	12 67	05	130		12				
Traytown	518	D.M.A.H.	12 67	05	297		4				
Traytown	519	D.M.A.H.	11 67	05	178		18				
Traytown	520	Paul Hunter	06 77	01	91	6	10		.25	DO	0-6 overburden 6-20 shale 20-91 granite

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Traytown	521	Edward S. Kean	06 77	01	150	6	12		5	DO	0-9 overburden
Trinity	522	Priscella Earle	09 73	08	136		8				
Trinity	523	A. Bailey			65		21				
Trinity	524	Royal Can. Legion			120		17				
Trinity	525	Community Council	05 77	08	142		24				
Trinity	526	Community Council	08 74	08	235		12				
Trinity	527	Community Council	03 74	08	100		20				
Trinity	528	S. Vokey	07 73	08	50		12				
Trinity	529	D.M.A.H.	01 75	08	200		12				
Trinity	530	R. Vokey	06 76	08	35		26		7		
Trinity	531	C. Brown	10 73	02	180	6	7		nil	DO	
Trinity	532	F.G. Tuff	09 73	02	125		7		.75	DO	
Trinity	533	Town Council	05 77	05	130		26		15		
Trinity	534	J. Rogers	04 77	05	250		21		2.5		
Trinity	535	J. Miller	07 79		225	6	14		1	DO	0-12 sand 12-112 siltstone 112-162 shale 162-225 siltstone
Trinity East	536	E. Jones	10 73	08	86		23				
Trinity East	537		04 74	08	96		9				
Trinity East	538	F. Cooper		08	105		22				
Trinity East	539	H. Laite	08 75	01	98	6			.5	DO	0-12.5 12.5 - 98
Trinity East	540	M. Cooper	08 75	01	170	6			1	DO	0-12 12-170
Trinity East	541	Gerald Hogarthy	06 77	01	115	6	20		.5	DO	0-15 sandy 15-115
Trinity East	542	Seymour Fowlow	04 78		125	6	5		.5		0-1 broken rock 1-125 sandstone
Trouty	543	D.M.A.H. (Cecil Bailey's well redrilled)	05 74	05	205		27		.5		
Trouty	544	J. Miller	06 77	01	85	6	9		.5	DO	0-4 boulders and sand 4-85 red shale
Trouty	545	Reg Bradbury			50		21		10		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date mo/yr	Driller	Depth ft	Casing		Static Water Level ft	Yield gpm	Water Use	Lithology
						Dia. in	Lgth. ft				
Trouty	546	C. Bailey	73	08	34	6	24		.5		
Trouty	547	Emil Johnson	07 79	01	170	6	30		4	DO	0-28 broken rock 28-170 siltstone
Trouty	548	J. Barnes	07 79	01	85	6	24		2	DO	0-22 gravel and boulders 22-85 granite
Winter Brook	549	George Elliot	06 80	04	100		20		1.5		


30'
15'
54°00'
45'
30'
15'
45'
30'
N
Joe Batt's Arm
Fogo
Shoal Bay
Deep Bay
FOGO ISLAND
Cape Cove
Island Harbour
Seldom
Western Indian Island
Harwood
Fredericton
Noggin Cove
Carmanville
Mann Point
Victoria Cove
Wings Point
Clarke's Head
Gander Bay
Gander Bay South
Barry's Ponds
Middle Arm
Eastern Arm
Musgrave Harbour
Doting Cove
Smith Pond
Straight Shore Bk
Shalloway Bk
Deadman's Bay
Gull Pond
Brook
Deadman's
△ 176±
Lumsden
FOGO DISTRICT △ 242±
BONAVISTA NORTH DISTRICT
RED HILL
Windmill Bight Provincial Park
Cape Freels North
30
103
40
112
9
10
11
12
13
14
15
16
17
17a
18

LEGEND

DUNNAGE ZONE

GANDER ZONE

SILURIAN

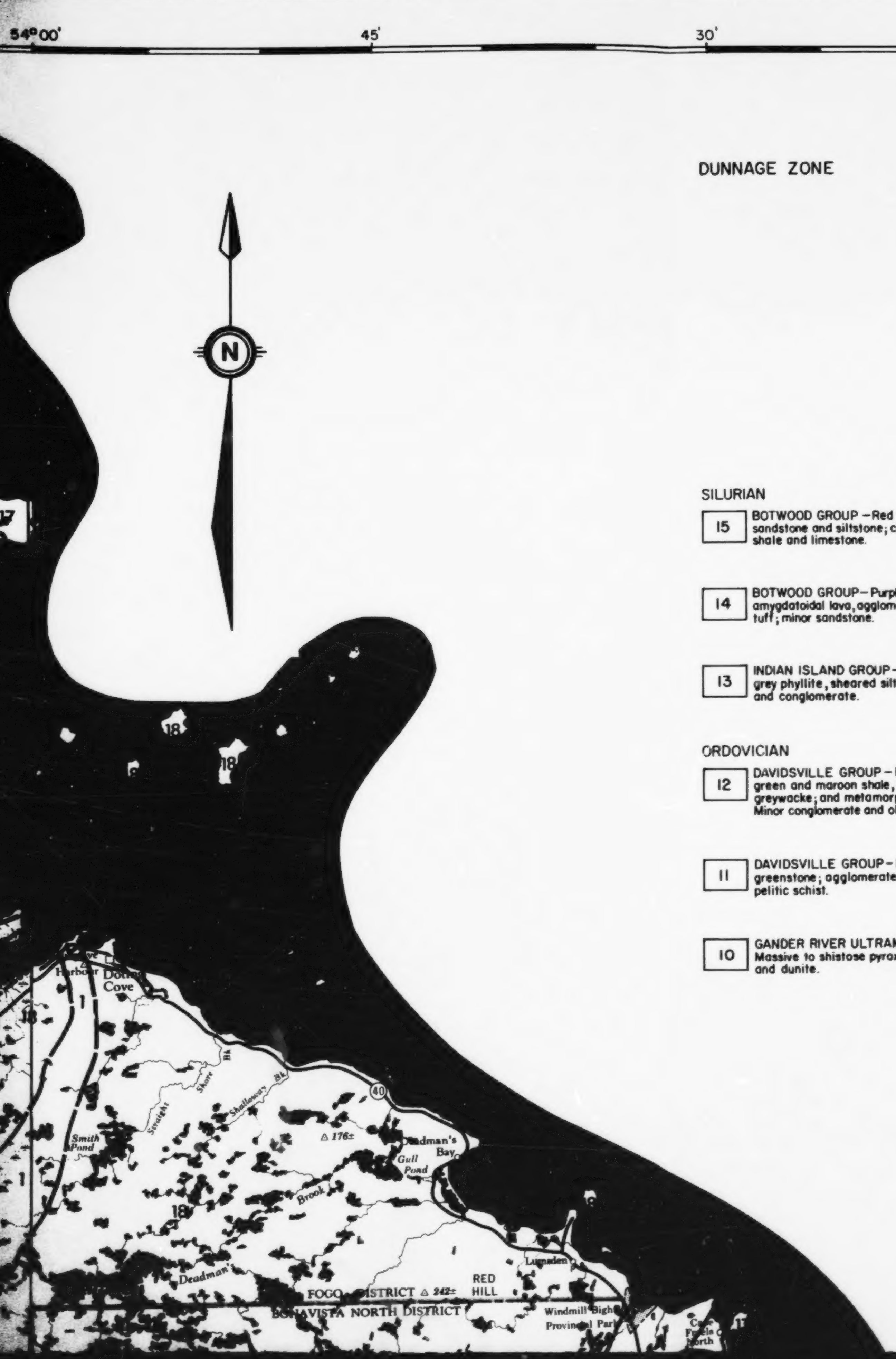
15	BOTWOOD GROUP — Red and grey micaceous sandstone and siltstone; conglomerate, shale and limestone.
14	BOTWOOD GROUP — Purple, red and green amygdaloidal lava, agglomerate, siliceous tuff; minor sandstone.
13	INDIAN ISLAND GROUP — Light and dark grey phyllite, sheared siltstone, sandstone and conglomerate.

ORDOVICIAN

12	DAVIDSVILLE GROUP — Black to grey-green and maroon shale, slate, siltstone and greywacke; and metamorphosed equivalents. Minor conglomerate and olistostrome breccia.
11	DAVIDSVILLE GROUP — Massive to pillowed greenstone; agglomerate, tuff; minor black pelitic schist.
10	GANDER RIVER ULTRAMAFIC BELT — Massive to shistose pyroxenite, peridotite and dunite.

Lower Ordovician or earlier

9	GANDER GROUP — Schistose psammites, semi-pelites and minor volcanic rocks.


54°00'
45'
30'
15'
53°00'
45'
30'
45'
30'
N
18
18
7
Harbour
Dover
Cove
1
18
Smith Pond
Straight
Shore
Bk
Shalloway
Bk
40
△ 176±
Deadman's
Bay
Gull
Pond
Brook
18
Deadman's
Lumsden
FOGO DISTRICT △ 242±
RED HILL
BONAVISTA NORTH DISTRICT
Windmill Bight
Provincial Park
Cape Freels North

LEGEND

DUNNAGE ZONE

SILURIAN

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ORDOVICIAN

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GANDER ZONE

Lower Ordovician or earlier

9	GANDER GROUP – Schistose psammites, semi-pelites and minor volcanic rocks.

AVALON ZONE

CAMBRIAN

Middle and Upper Cambrian

8	HARCOURT GROUP – Grey to black shale or slate and siltstone; minor black limestone. In part lower Ordovician in age.

Early to Middle Cambrian

7	ADEYTON GROUP – Red, green and purple shale and slate; minor grey, pink and green limestone; thin white calcareous sandstone at base.

Early Cambrian

6	RANDOM FORMATION – White, grey-green and pink quartzite and sandstone.

PLUTONIC ROCKS

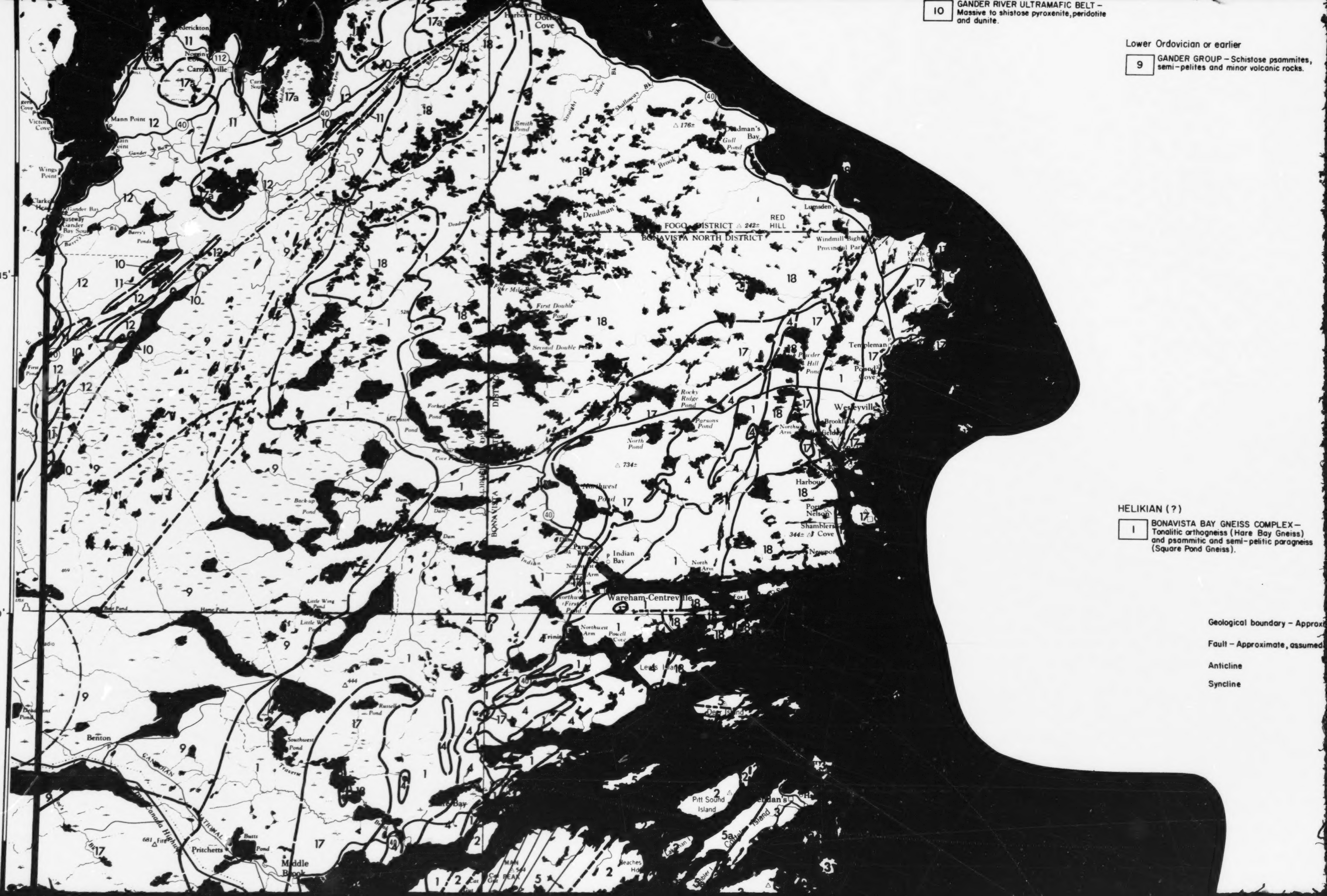
CARBONIFEROUS OR EARLIER

18	Massive medium- to coarse-grained and megacrystic biotite granite

DEVONIAN OR EARLIER

17	Foliated to massive biotite and muscovite-biotite granite, commonly garnetiferous 17a – Quartz monzonite and quartz diorite.
16	Diorite, quartz diorite and gabbro; basic to ultrabasic rocks at Tilting and Burnt Point, Fogo Island.

PALEOZOIC



10 **GANDER RIVER ULTRAMAFIC BELT** – Massive to shistose pyroxenite, peridotite and dunite.

Lower Ordovician or earlier

9 **GANDER GROUP** – Schistose psammites, semi-pelites and minor volcanic rocks.

HELIKIAN (?)

1 **BONAVISTA BAY GNEISS COMPLEX** – Tonalitic orthogneiss (Hare Bay Gneiss) and psammitic and semi-pelitic paragneiss (Square Pond Gneiss).

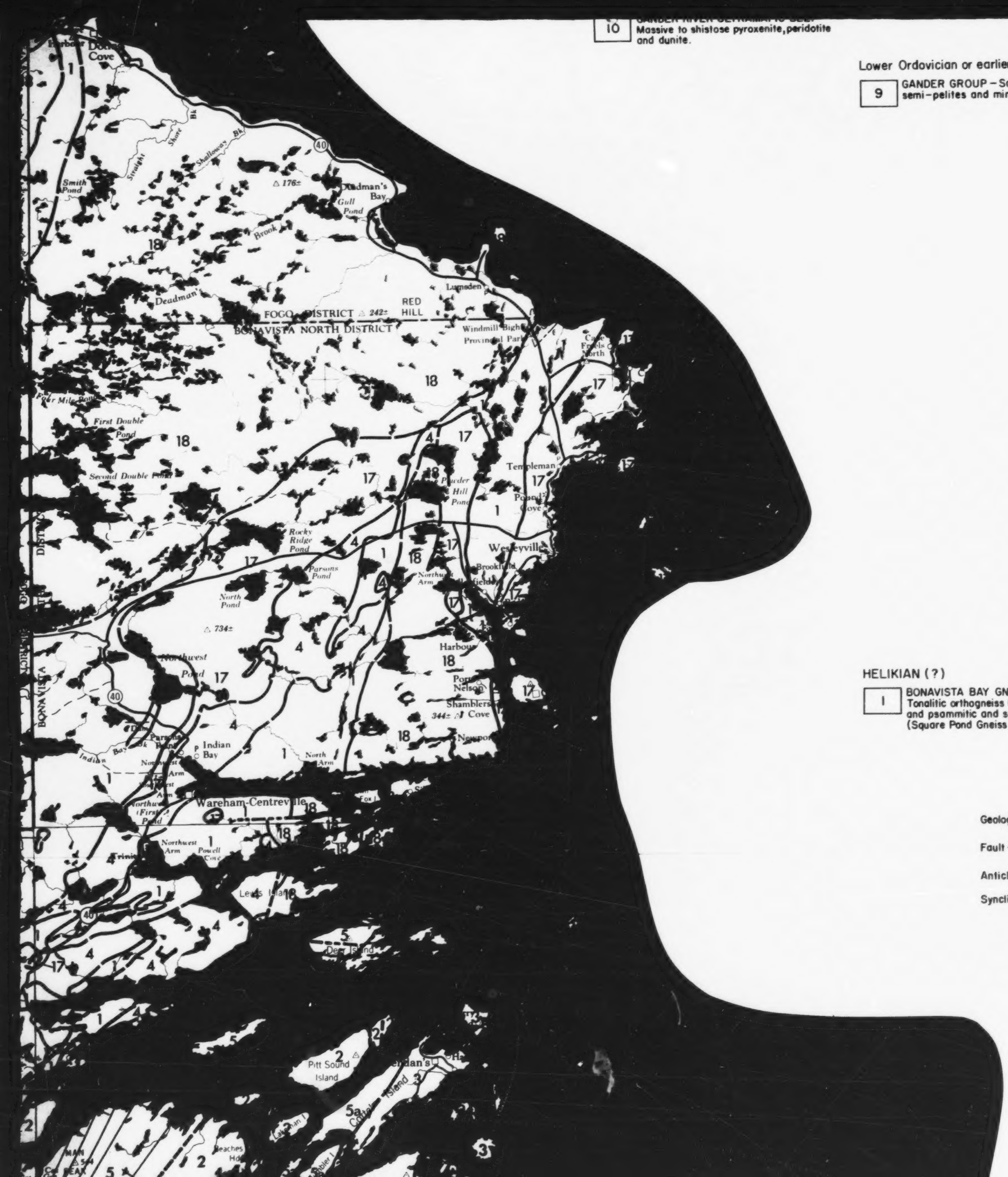
Geological boundary – Approx

Fault – Approximate, assumed

Anticline

Syncline

15'
49°00'
Fredrickton
Noggin Cove
Carmanville
Mann Point
Victoria Cove
Wings Point
Clarke's Head
Gander Bay
Causeway
Gander Bay South
Barry's Ponds
Gander
Smith Pond
Straight Shore
Shalloway Bk
Deadman's Bay
Gull Pond
Brook
Deadman's
FOGO DISTRICT
BONAVISTA NORTH DISTRICT
RED HILL
Lumsden
Windmill Bight Provincial Park
Four Mile Pond
First Double Pond
Second Double Pond
Templeman
Powder Hill Pond
Pound Cove
Wesleyville
Brookfield
Rocky Ridge Pond
Parsons Pond
North Pond
Northwest Pond
Forked Pond
Morrissan Pond
Back-up Pond
Dam
BONAVISTA
Northwest Arm
Harbour
Port Nelson
Shamblers Cove
Newport
Indian Bay
North Arm
Wareham-Centreville
Northwest (First) Pond
Powell Cove
Little Wing Pond
Lewis Island
Deer Island
Russell Pond
Southwest Pond
Benton
CANADIAN NATIONAL
Trans Canada Highway
Pritchetts
Butts Pond
Middle Brook
Pitt Sound Island
Cottel Island
Beaches
Traverse
40
112
176±
242±
734±
344±
444
681
1
2
4
5
5a
9
10
11
12
17
17a
18


Dover Cove
Smith Pond
Straight Shore
Shalloway Bk
40
△ 176±
Deadman's Bay
Gull Pond
Brook
18
Deadman
FOGO DISTRICT △ 242±
BONAVISTA NORTH DISTRICT
RED HILL
Lumsden
Windmill Bight Provincial Park
Cape Freels North
18
17
Four Mile Pond
First Double Pond
Second Double Pond
18
17
4
Templeman
Powder Hill Pond
Pound Cove
1
Rocky Ridge Pond
Parsons Pond
Wesleyville
Brookfield
North Pond
North Arm
△ 734±
Northwest Pond
Harbour
Port Nelson
Shamblers Cove
344± Cove
Newport
BONAVISTA
Indian Bay
North Arm
Wareham-Centreville
Northwest Arm
Powell Cove
Trinity
Leeds Island
Deer Island
Pitt Sound Island
Cottel Island
Beaches
MAN O'WAR PEAK

10 Massive to shistose pyroxenite, peridotite and dunite.

Lower Ordovician or earlier

9 GANDER GROUP – Schistose psammites, semi-pelites and minor volcanic rocks.

CAMBRIAN

Middle and Upper Cambrian

8 HARCOURT GROUP – Grey to black shale or slate and siltstone; minor black limestone. In part lower Ordovician in age.

Early to Middle Cambrian

7 ADEYTON GROUP – Red, green and purple shale and slate; minor grey, pink and green limestone; thin white calcareous sandstone at base.

Early Cambrian

6 RANDOM FORMATION – White, grey-green and pink quartzite and sandstone.

HADRYNIAN

5 MUSGRAVETOWN GROUP – Red, green and grey pebble conglomerate, sandstone and shale; minor lava and tuff.
5b – BULL ARM FORMATION – Principally acidic and basic volcanic rock with minor Interbedded sedimentary rock. In part early Cambrian in age.

3 CONNECTING POINT GROUP – Green to black greywacke, cherty quartzite, slate; some sandstone and conglomerate; red siltstones in Southern Bay.

2 LOVE COVE GROUP – Metamorphosed basic to acadic volcanic rocks; Interbedded sandstone and conglomerate in places.

HADRYNIAN (?)

4 Foliated granite, quartz monzonite and quartz diorite.

PRECAMBRIAN

HELIKIAN (?)

1 BONAVISTA BAY GNEISS COMPLEX – Tonalitic orthogneiss (Hare Bay Gneiss) and psammitic and semi-pelitic paragneiss (Square Pond Gneiss).

Geological boundary – Approximate.

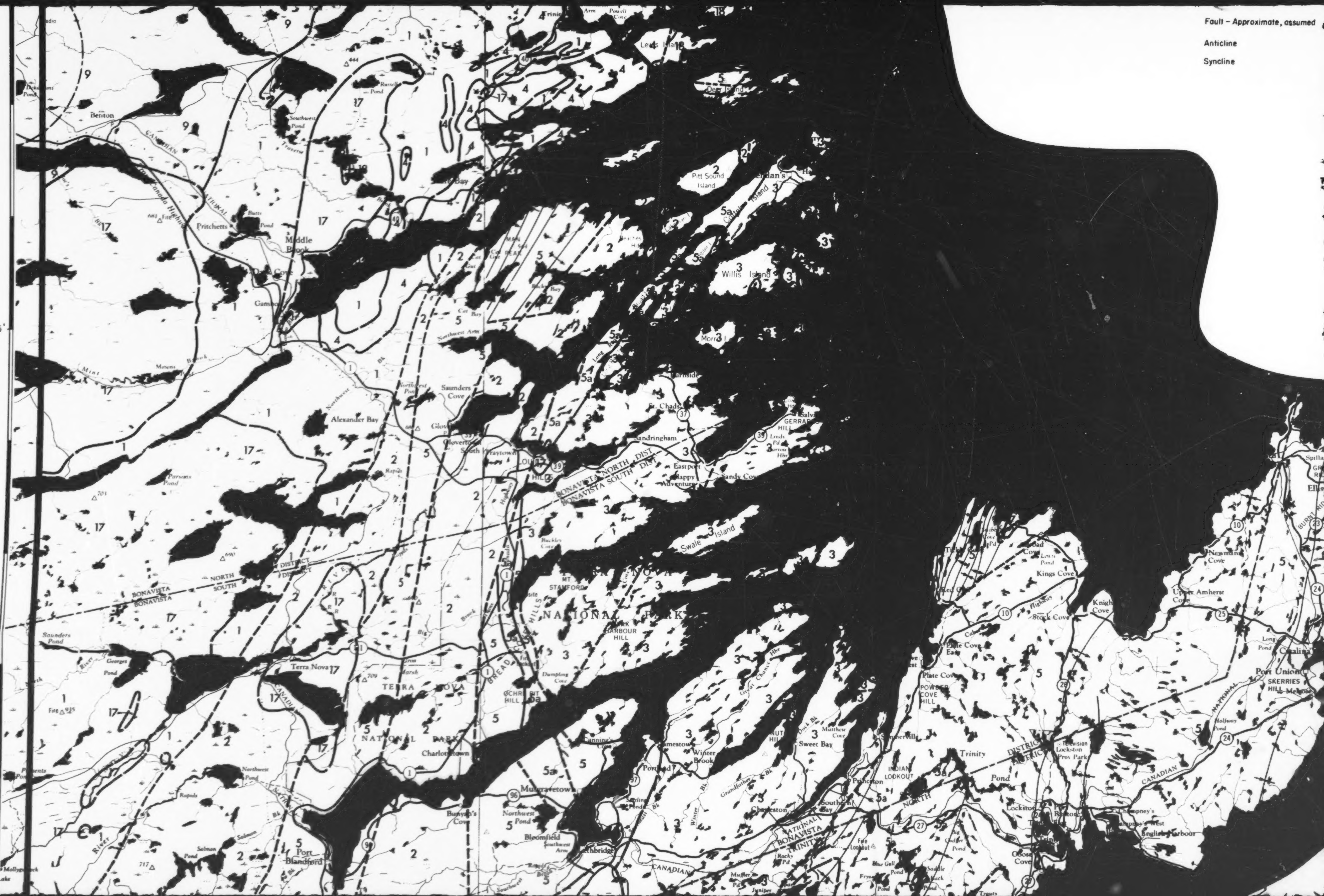
Fault – Approximate, assumed

Anticline

Syncline

15'

49° 00'

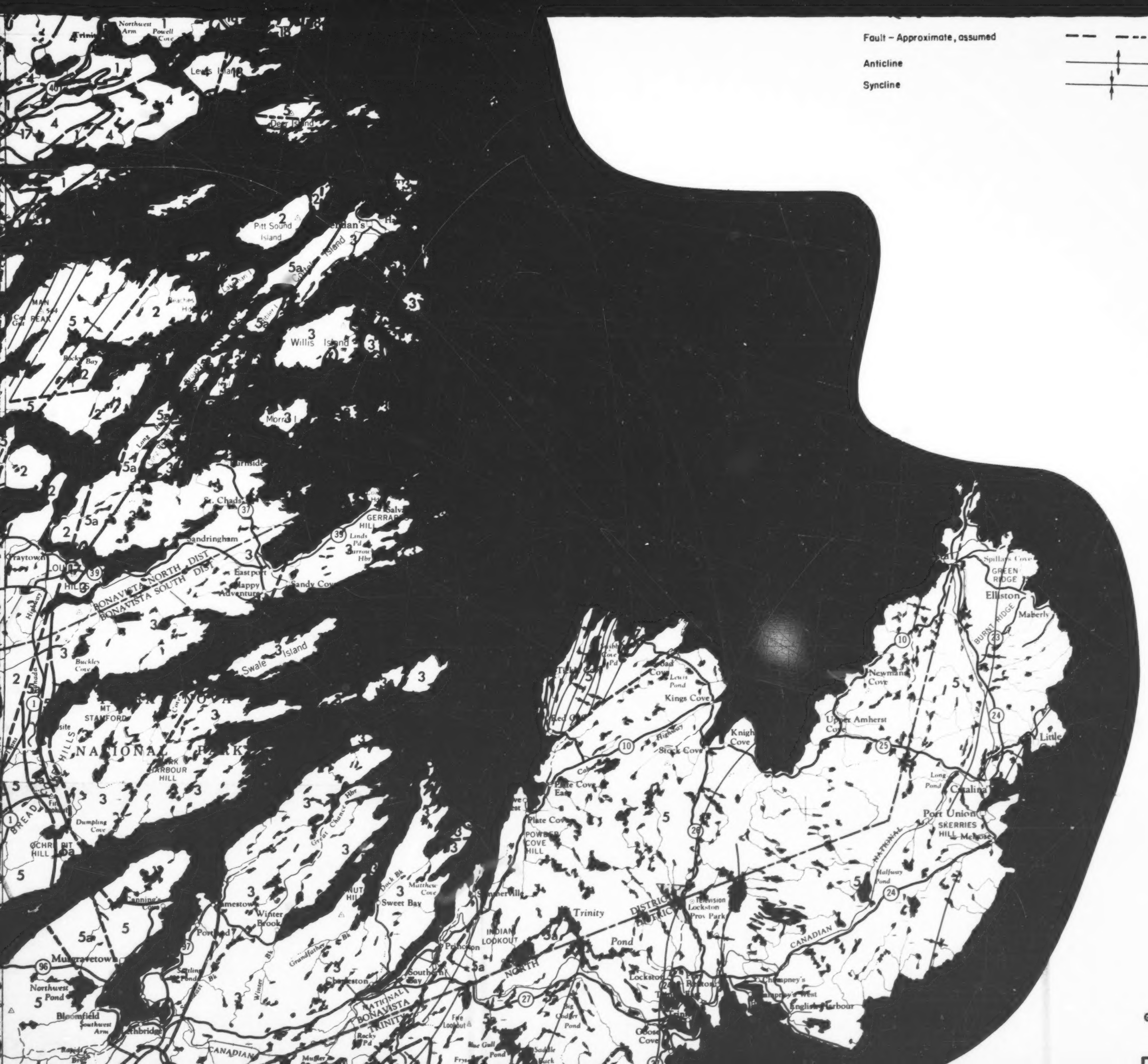


Fault - Approximate, assumed
Anticline
Syncline
45'
30'
Benton
Pritchetts
Middle Brook
Gambo
Alexander Bay
Saunders Cove
Glovertown South
Traytown
Terra Nova
TERRA NOVA NATIONAL PARK
Charlottetown
Port Blandford
Musgravetown
Bloomfield
Lethbridge
Pitt Sound Island
Willis Island
Deer Island
Swale Island
St. Chads
Burnside
Sandringham
Eastport
Happy Adventure
Sandy Cove
GERRARD HILL
BONAVISTA NORTH DIST
BONAVISTA SOUTH DIST
BONAVISTA NORTH
BONAVISTA SOUTH
MT STAMFORD
PARK HARBOUR HILL
OCHRE PIT HILL
Dumpling Cove
Buckley Cove
Saunders Pond
Georges Pond
Northwest Pond
Bunyan's Cove
Jamestown
Winter Brook
Sweet Bay
Portland
Charleston
Southern Bay
Princeton
INDIAN LOOKOUT
Trinity
Lockston
Plate Cove
Plate Cove East
POWDER COVE HILL
Kings Cove
Stock Cove
Knights Cove
Bad Cove
Red Cliff
Upper Amherst Cove
Newmans Cove
Catalina
Port Union
SKERRIES HILL
Champney's
Champney's West
English Harbour
Goose Cove
Halfway Pond
Long Pond
Great Chance Hbr
Matthew Cove
Duck Bk
Canning's Cove
Southwest Pond
Russells Pond
Mint Brook
Parsons Pond
Fire △ 915
△ 709
△ 703
△ 690
CANADIAN NATIONAL
TRANS CANADA HIGHWAY

Fault – Approximate, assumed — — – - – -

Anticline

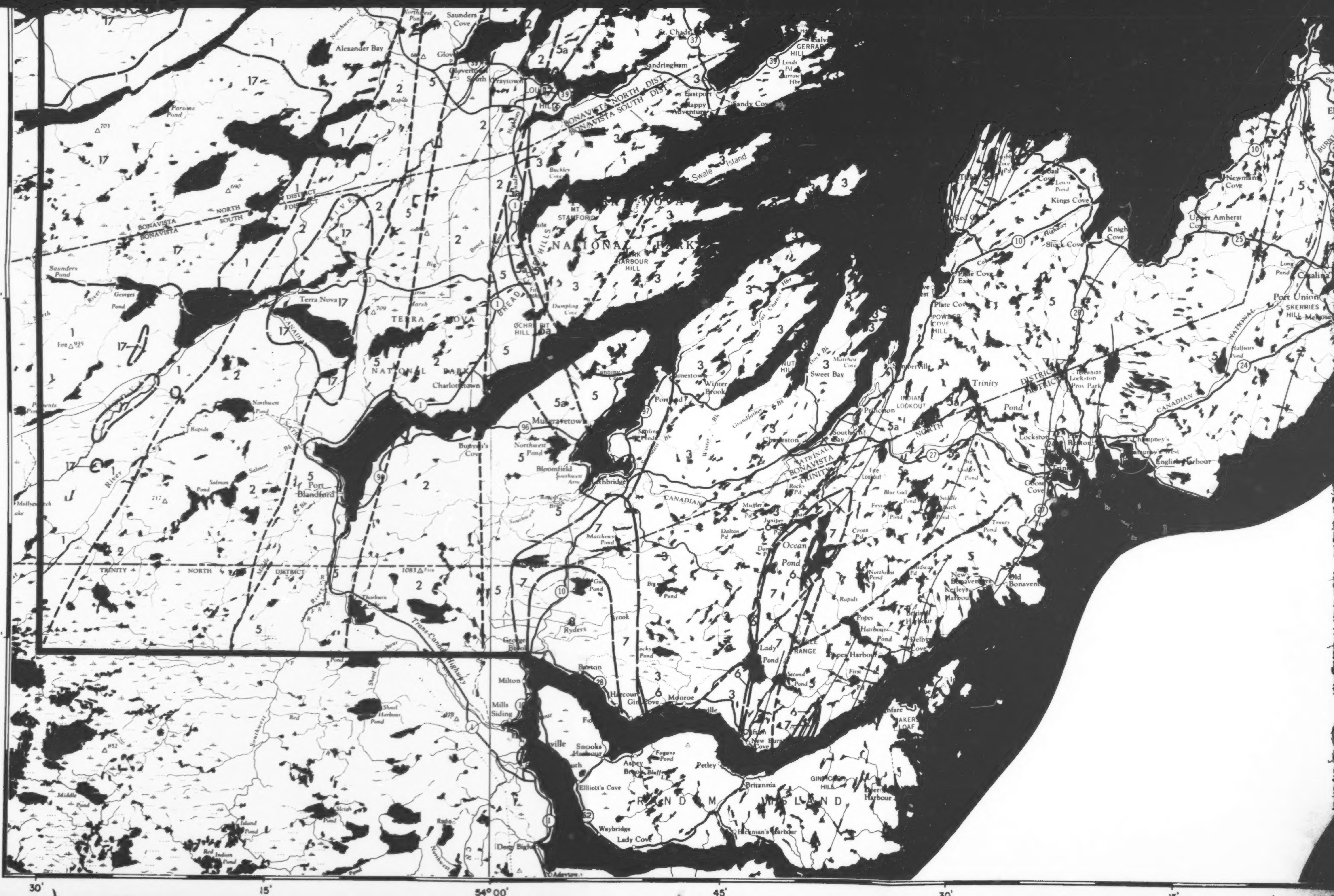
Syncline

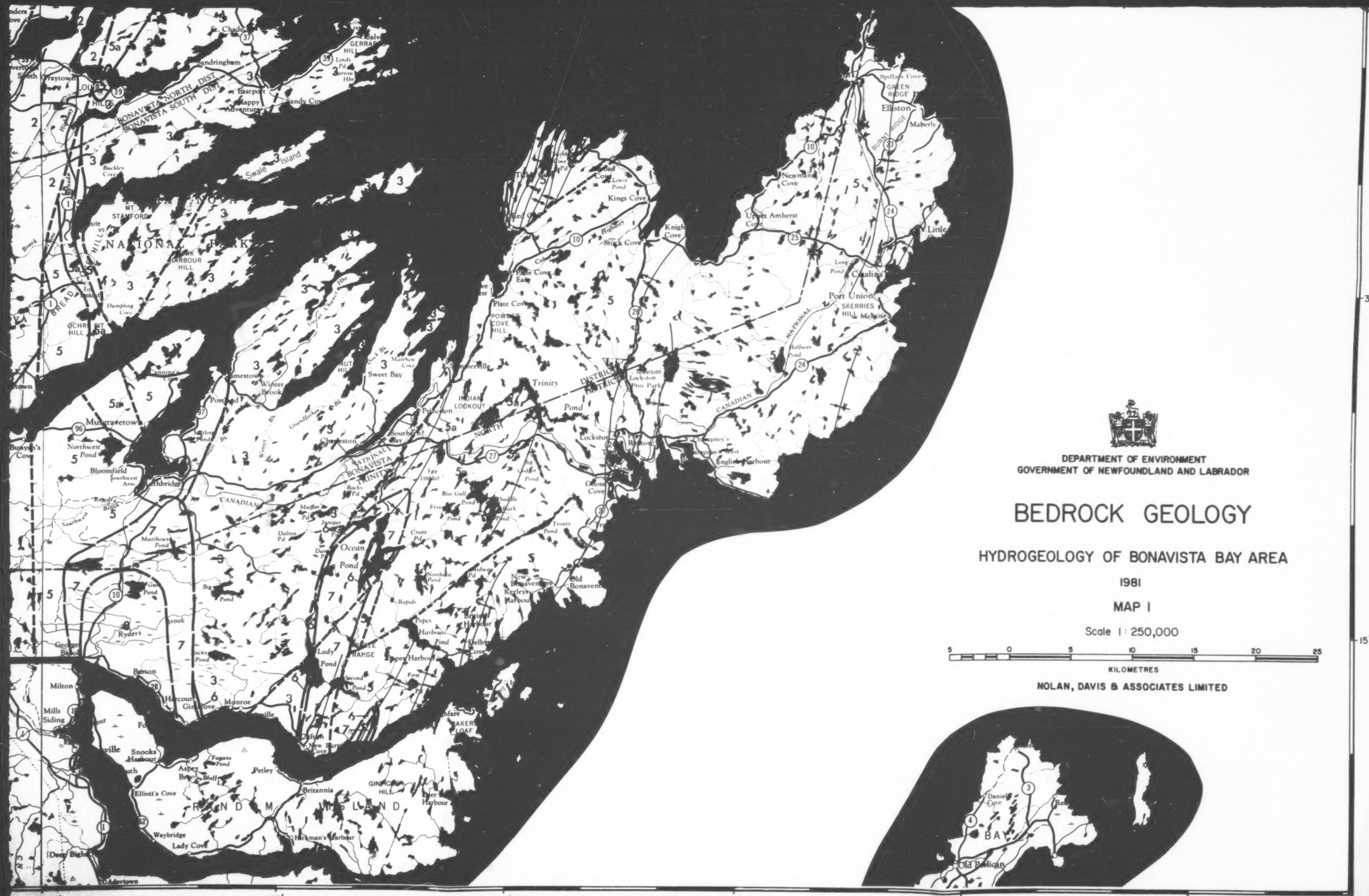


Northwest Arm
Powell Cove
Trinity
Lewis Island
Deer Island
Pitt Sound Island
Sheridan's
Cottel Island
Willis Island
Morris I.
MAN PEAK
Bloody Bay
Burnside
St. Chads
Salvage
GERRARD HILL
Lands Pd
Burrows Hbr
Sandringham
Glovertown
LOUNT HILLS
Eastport
Happy Adventure
Sandy Cove
BONAVISTA NORTH DIST.
BONAVISTA SOUTH DIST.
Buckley Cove
Swale Island
MT STAMFORD
TERRA NOVA
NATIONAL PARK
ARK HARBOUR HILL
Dumpling Cove
OCHRE PIT HILL
Great Chance Hbr
Canning's Cove
Jamestown
Winter Brook
Portland
Mulgravetown
Northwest Pond
Bloomfield
Southwest Arm
Lethbridge
CANADIAN
NUT HILL
Duck Bk
Matthew Cove
Sweet Bay
Summerville
INDIAN LOOKOUT
Princeton
Southern Bay
Charleston
NATIONAL
BONAVISTA
TRINITY
Plate Cove East
Plate Cove
POWDER COVE HILL
Red Cliff
Tickle Cove
Lewis Pond
Open Hall
Kings Cove
Stock Cove
Knights Cove
Upper Amherst Cove
Newmans Cove
Spillars Cove
GREEN RIDGE
Elliston
BURNT RIDGE
Maberly
Little
Long Pond
Catalina
Port Union
SKERRIES HILL
Melrose
Halfaway Pond
Trinity
DISTRICT
Lockston
Television
Lockston Prov Park
Pond
Champney's
Champney's West
English Harbour
Goose Cove
Big Gulch Pond
Blue Gull Pond
Saddle Back
Fox Lookout
Rocky Pd
1
2
3
4
5
5a
10
17
18
23
24
25
26
27
37
39
40
96
45'
30'

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

BEDROCK GEOLOGY


Saunders Cove
Alexander Bay
Glovertown South
Traytown
St. Chads
Sandringham
Eastport
Happy Adventure
Sandy Cove
Salvage
GERRARD HILL
BONAVISTA NORTH DIST
BONAVISTA SOUTH DIST
Parsons Pond
Swale Island
Buckley Cove
TERRA NOVA
NATIONAL PARK
MT STANFORD
HARBOUR HILL
Dumpling Cove
BREAD COVE HILLS
OCHRE PIT HILL
Saunders Pond
Georges Pond
Terra Nova
Charlottetown
Canning's Cove
Jamestown
Winter Brook
Portland
Sweet Bay
Matthews Cove
Great Chance Hbr
Newmans Cove
Upper Amherst Cove
Knight Cove
Kings Cove
Stock Cove
Plate Cove East
Plate Cove West
POWDER COVE HILL
Red Cliff
Catalina
Port Union
SKERRIES HILL
Melrose
Halfway Pond
Television Lockston Prov. Park
Trinity
INDIAN LOOKOUT
Princeton
Southern Bay
Charleston
Musgravetown
Bunyan's Cove
Northwest Pond
Bloomfield
Lethbridge
Port Blandford
Salmon Pond
Northwest Pond
Mollyguajeck Lake
TRINITY NORTH DISTRICT
BONAVISTA NORTH
TRINITY NORTH
CANADIAN NATIONAL
Matthews Pond
Dalton Pd
Muffler Pd
Juniper Pd
Ocean Pond
Cross Pd
Blue Gull Pond
Saddle Back Pond
Trouty Pond
Goose Cove
Lockston
Port Rexton
Trinity
Champney's West
English Harbour
New Bonaventure
Old Bonaventure
Kerleys Harbour
Popes Harbour
British Harbour
Delby Cove
Lady Pond
Second Pond
First Pd
Thorburn Lake
Gull Pond
Big Pond
Ryders
George's Brook
Rocky Pond
Trans-Canada Highway
Milton
Mills Siding
Barton
Harcourt
Gin Cove
Monroe
Clifton
New Burnt Cove
Snooks Harbour
Aspey Brook
Fagans Pond
Petley
Britannia
GINNICK HILL
Dyer's Harbour
Hickman's Harbour
Elliott's Cove
Weybridge
Lady Cove
RANDOM ISLAND
Shoal Harbour Pond
Deep Bight
Adeyton
Middle Pond
Sleigh Pond
Island Pond
Red Indian Pond
1083 Fire
Fire 935
30'
15'
30'
15'
54°00'
45'
30'
15'


St. Chads
Gerrard Hill
Sandringham
Eastport
Happy Adventure
Sandy Cove
Bonavista North Dist.
Bonavista South Dist.
Swale Island
Buckley Cove
Mt. Stamford
National Park
Park Harbour Hill
Dumpling Cove
Ochre Pit Hill
Traytown
Mulgravetown
Northwest Pond
Bunyan's Cove
Bloomfield
Lethbridge
Portland
Jamestown
Winter Brook
Sweet Bay
Charleston
Southern Bay
Princeton
Indian Lookout
Summerville
Plate Cove
Powder Cove Hill
Kings Cove
Stock Cove
Knight Cove
Trinity
Trinity North District
Lockston
Port Rexton
Goose Cove
Trinity Pond
New Bonaventure
Kerleys Harbour
Old Bonaventure
British Harbour
Popes Harbour
Lady Pond
Ocean Pond
Cross Pd
Matthews Pond
Big Pond
Ryders
Rocky Pond
Barton
Harcourt
Gin Cove
Monroe
Clifton
New Bury Cove
Georges Brook
Milton
Mills Siding
Snooks Harbour
Aspey Brook
Petley
Britannia
Random Island
Ginnicks Hill
Hickman's Harbour
Elliott's Cove
Weybridge
Lady Cove
Deep Bight
Adeytown
Baker's Loaf
Upper Amherst Cove
Newmans Cove
Elliston
Green Ridge
Spillars Cove
Maberly
Burnt Ridge
Little Catalina
Catalina
Port Union
Skerries Hill
Melrose
Long Pond
Halfway Pond
Champney's
Champney's West
English Harbour
Canadian National
Daniels Cove
Old Perlican
Bay
Television Lookout Prov. Park
54°00'
45'
30'
15'
53°00'
45'
30'
15'

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

BEDROCK GEOLOGY

HYDROGEOLOGY OF BONAVISTA BAY AREA

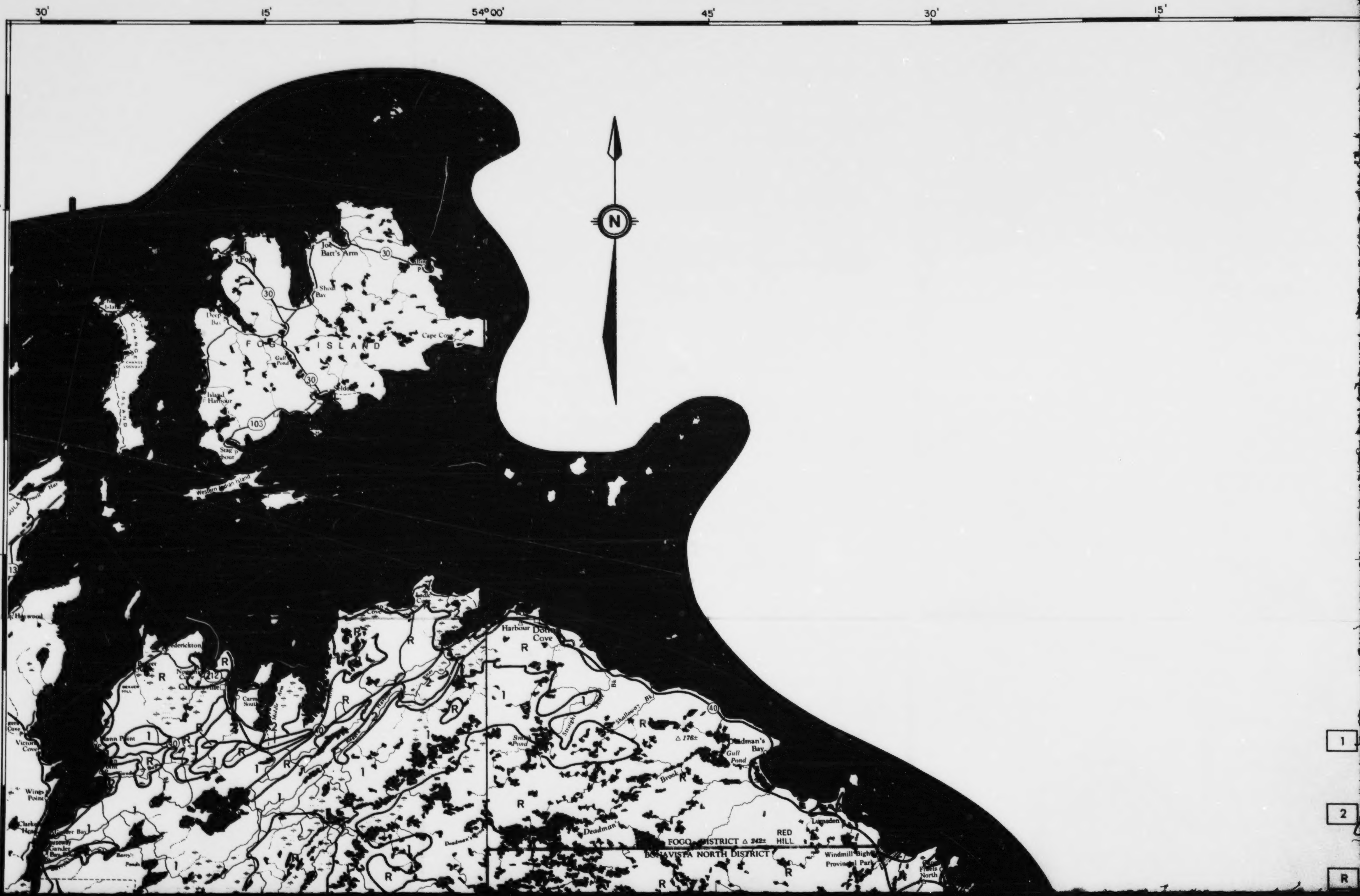
1981

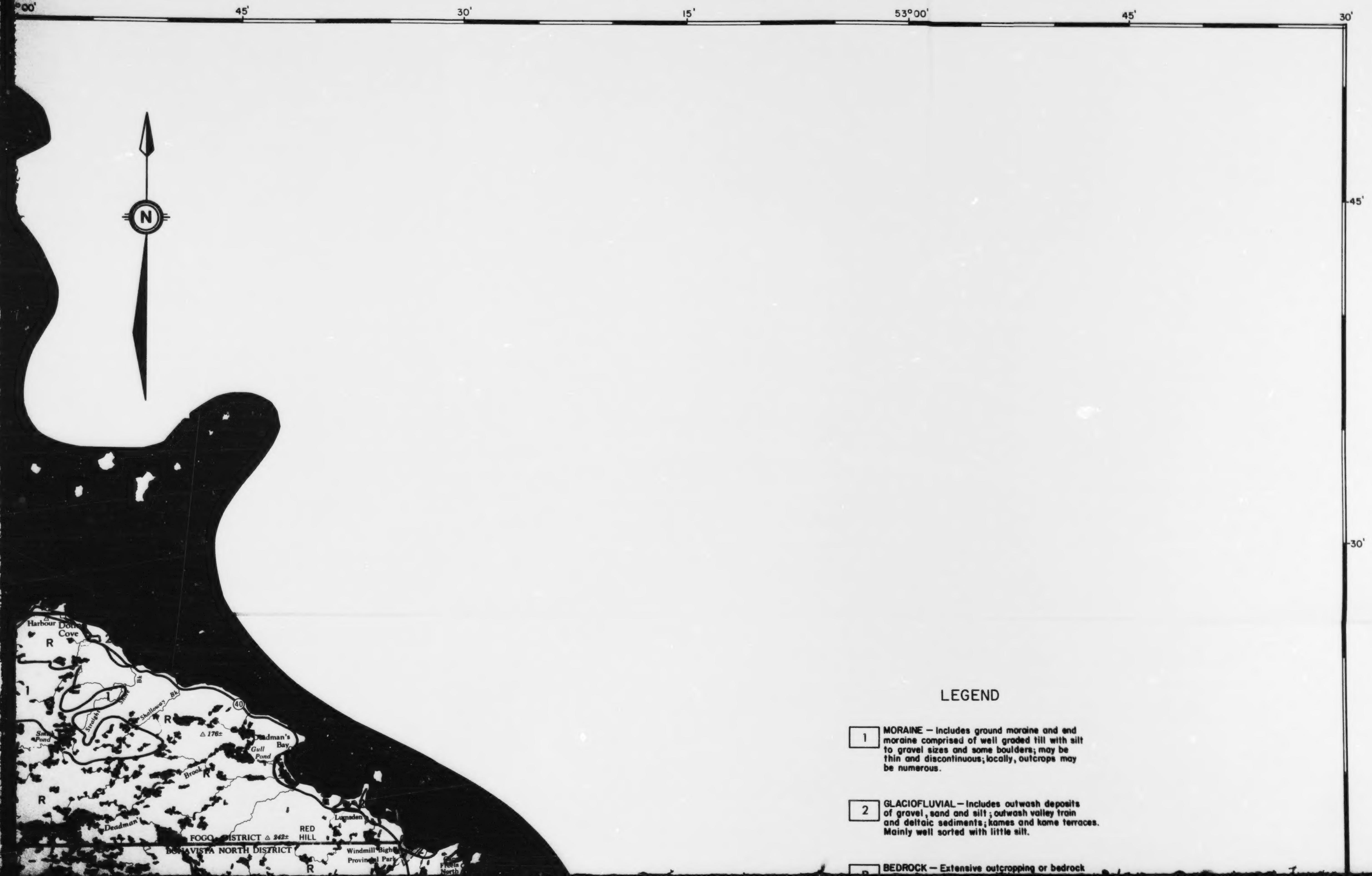
MAP 1

Scale 1 : 250,000

5 0 5 10 15 20 25
KILOMETRES

NOLAN, DAVIS & ASSOCIATES LIMITED


30'
15'
54°00'
45'
30'
15'
45'
30'
N
Joe Batt's Arm
30
Fogo
Shoal Bay
Deep Bay
FOGO ISLAND
Gull Pond
Cape Cove
Seldom
Island Harbour
103
Stag Harbour
CHANGE ISLANDS
CHANGE LOOKOUT
Western Indian Island
13
Heywood
Fredrickton
Noggin Cove
Carmanville
212
Carmanville South
Middle Arm
Musgrave Harbour
Doting Cove
Mann Point
Victoria Cove
Wings Point
Clarke's Head
Gander Bay South
Berry's Ponds
Deadman's
Smith Pond
Straight Shoot Bk
Shalloway Bk
Brook
Deadman's Bay
Gull Pond
△ 176±
40
Lumsden
FOGO DISTRICT △ 242±
RED HILL
BONAVISTA NORTH DISTRICT
Windmill Bight Provincial Park
Cape Freels North
R
1
2
1
2
R

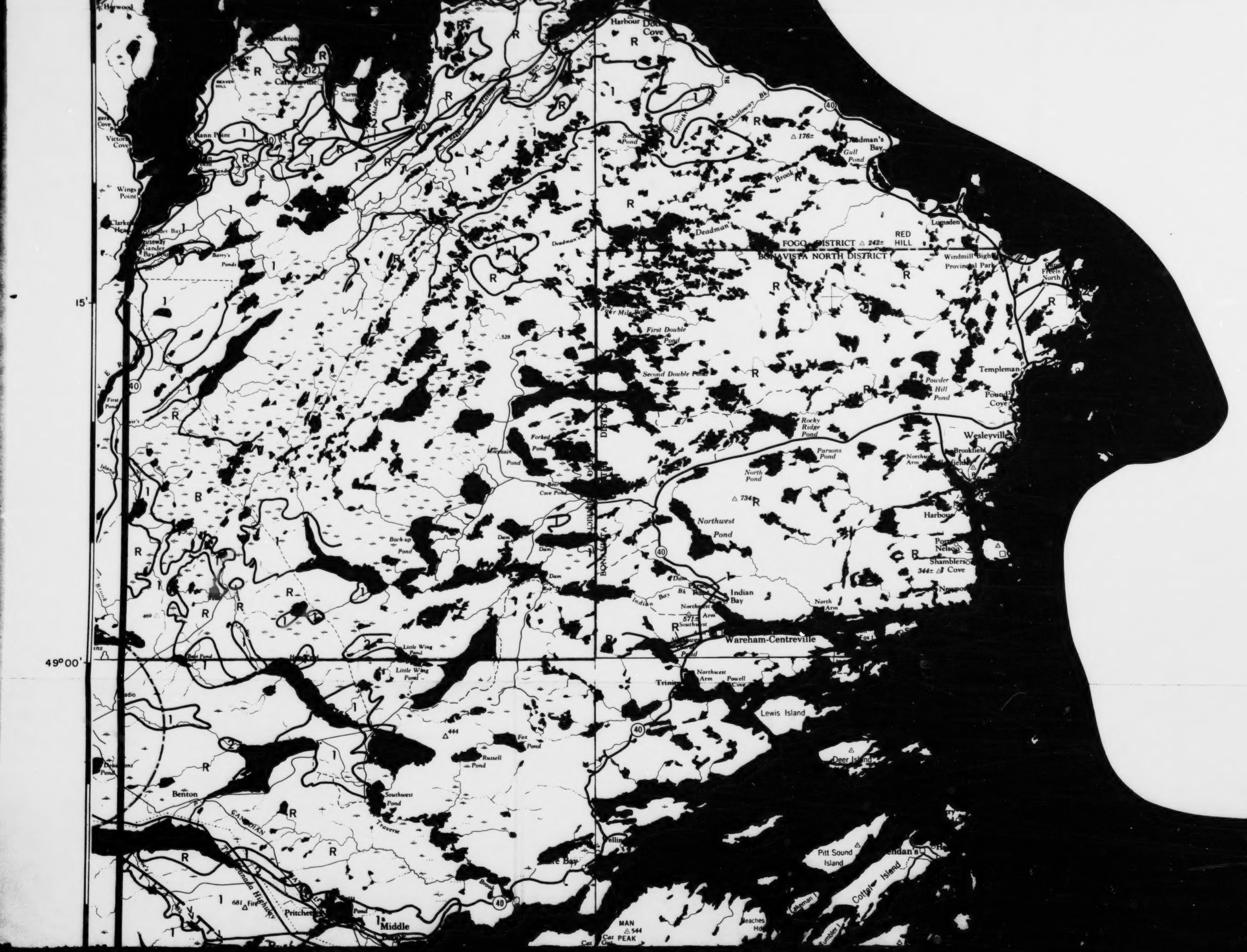

00'
45'
30'
15'
53°00'
45'
30'
45'
30'
N
Harbour
Doting Cove
R
1
1
Shoe Bk
Straight
Shalloway Bk
40
R
Smith Pond
△ 176±
Deadman's Bay
Gull Pond
Brook
R
R
Deadman's
Lumsden
RED HILL
FOGO DISTRICT △ 242±
BONAVISTA NORTH DISTRICT
Windmill Bight Provincial Park
R
Cape Freels North

LEGEND

1 MORAINE — Includes ground moraine and end moraine comprised of well graded till with silt to gravel sizes and some boulders; may be thin and discontinuous; locally, outcrops may be numerous.

2 GLACIOFLUVIAL — Includes outwash deposits of gravel, sand and silt; outwash valley train and deltaic sediments; kames and kame terraces. Mainly well sorted with little silt.

R BEDROCK — Extensive outcropping or bedrock


15'
49°00'
Harwood
Fredericton
Carmanville
Carmanville South
Beaver Hill
Victoria Cove
Wings Point
Clarke's Head
Gander Bay
Barry's Ponds
First Pond
Island
Harbour
Doting Cove
Small Pond
Shalloway Bk
Deadman's Bay
Gull Pond
Deadman's Brook
176±
FOGO DISTRICT
BONAVISTA NORTH DISTRICT
242±
RED HILL
Lumsden
Windmill Bight Provincial Park
Cape Freels North
Four Mile Pond
First Double Pond
Second Double Pond
Templeman
Powder Hill Pond
Pound Cove
Rocky Ridge Pond
Parsons Pond
Wesleyville
Brookfield
North Pond
Northwest Arm
734
Northwest Pond
Forked Pond
Moccasin Pond
Big Bear Cove Pond
Back-up Pond
Dam
Port Nelson
Shamblers Cove
344±
Newport
Indian Bay
Indian Bay Bk
North Arm
Northwest Arm
571±
Southwest Arm
Wareham-Centreville
Little Wing Pond
Trinity
Northwest Arm
Powell Cove
Lewis Island
Deer Island
444
Fox Pond
Russell Pond
Southwest Pond
Benton
Traverse
Pitt Sound Island
Greenspond
Cottel Island
Beaches
Pritchett
681 Fire
Middle
MAN PEAK
544
Cat Cove
Trans-Canada Highway
Canadian National
40
1
2
R

1

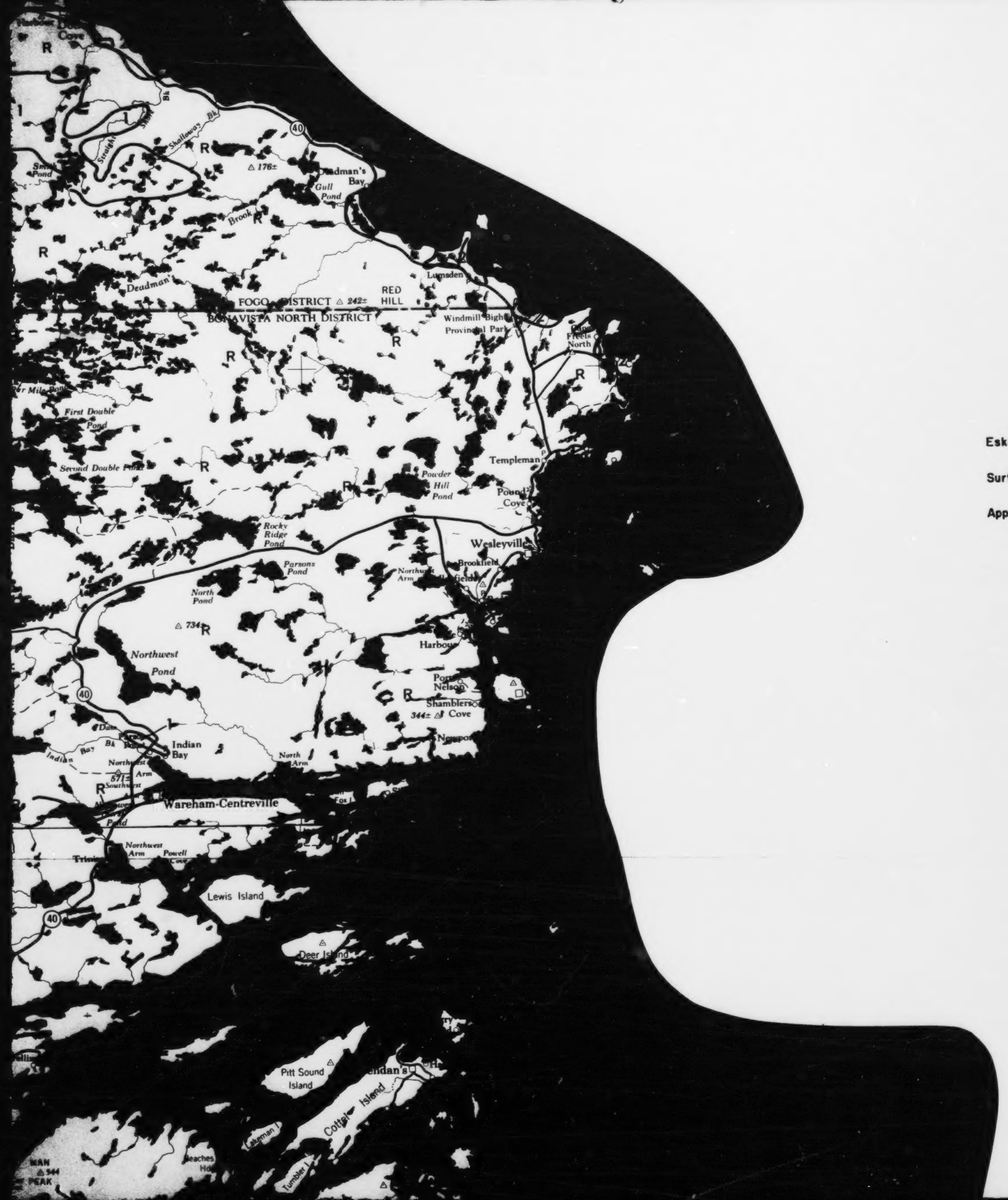
2

R

Eskers (in direction of st

Surficial hydrogeological

Approximate division of j



Cove
R
Shalloway Bk
Straight
Smith Pond
△ 176±
Deadman's Bay
Gull Pond
Brook
40
Deadman
Lumsden
FOGO DISTRICT △ 242±
RED HILL
BONAVISTA NORTH DISTRICT
Windmill Bight Provincial Park
Cape Freels North
First Double Pond
Second Double Pond
Templeman
Powder Hill Pond
Pound Cove
Rocky Ridge Pond
Wesleyville
Parsons Pond
Brookfield
Northwest Arm
North Pond
△ 734
Northwest Pond
Harbour
Port Nelson
Shamblers Cove
344± △
Indian Bay
Indian Bay Bk
Northwest Arm
Southwest Arm
North Arm
Wareham-Centreville
Northwest Arm
Powell Cove
Lewis Island
Deer Island
Pitt Sound Island
Cottel Island
Lakeman
Beaches
Tumbler I.
MAN △ 544 PEAK

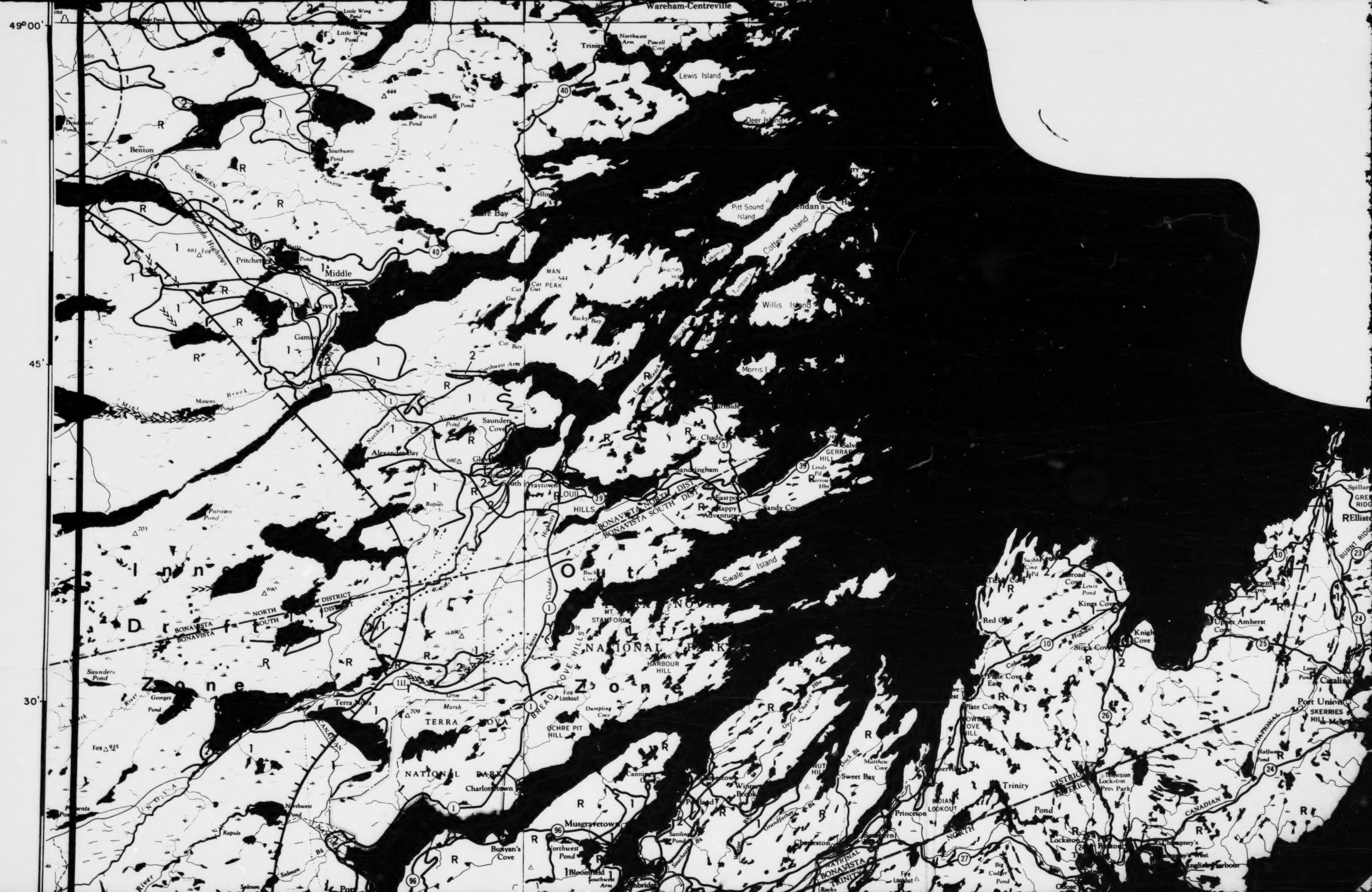
15'

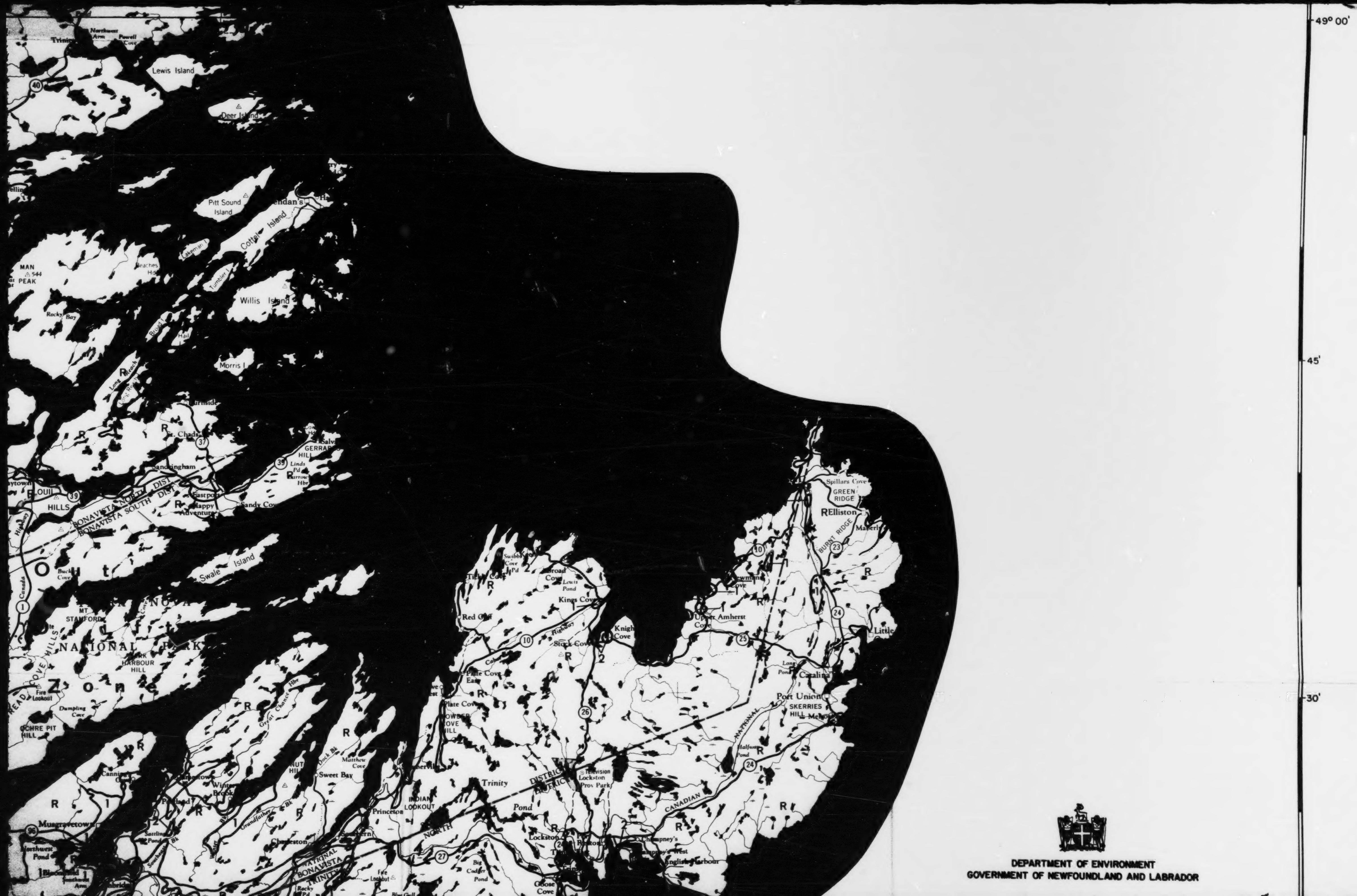
49° 00'

LEGEND

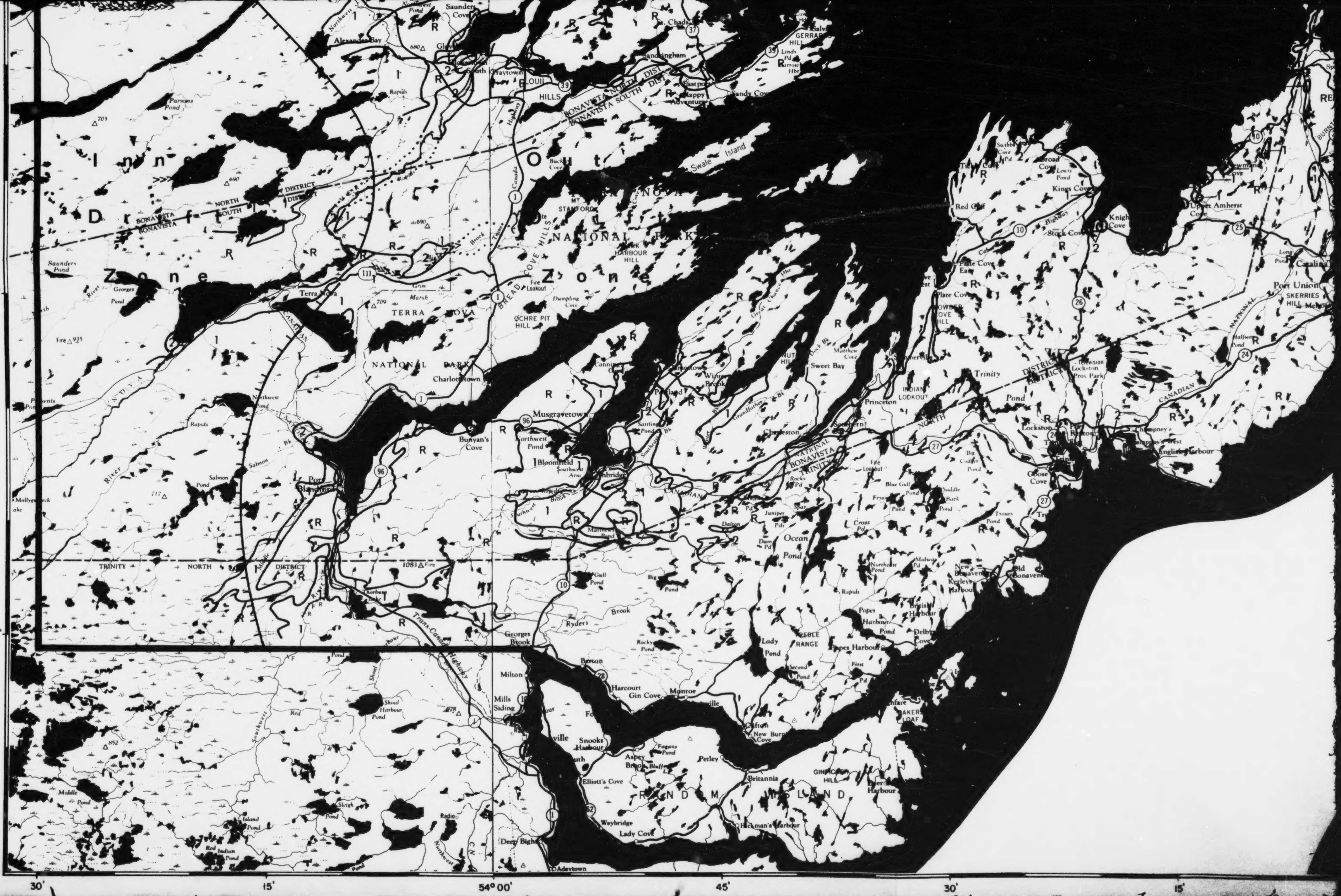
1	**MORAINE** — Includes ground moraine and end moraine comprised of well graded till with silt to gravel sizes and some boulders; may be thin and discontinuous; locally, outcrops may be numerous.
2	**GLACIOFLUVIAL** — Includes outwash deposits of gravel, sand and silt; outwash valley train and deltaic sediments; kames and kame terraces. Mainly well sorted with little silt.
R	**BEDROCK** — Extensive outcropping or bedrock concealed by thin veneer of topsoil.

Eskers (in direction of stream flow).	>>>>>>>>>
Surficial hydrogeological unit boundary — Approximate, assumed.	~ ......
Approximate division of inner and outer drift zone.	⌒

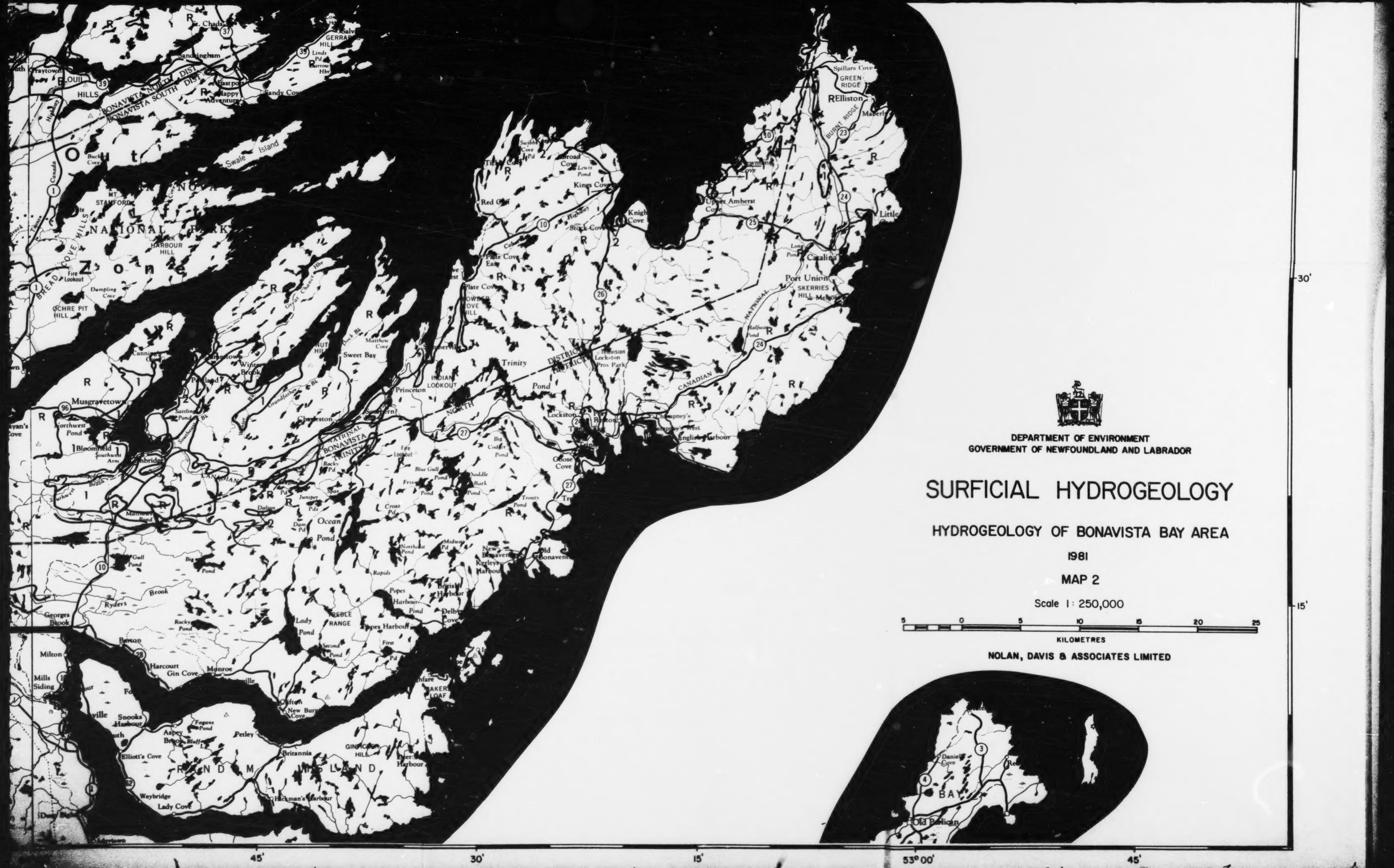

49°00'
45'
30'
Wareham-Centreville
Little Wing Pond
Trinity
Northwest Arm
Powell Cove
Lewis Island
Deer Island
Fox Pond
Russell Pond
Southwest Pond
Benton
Traverse
Pitt Sound Island
Cottel Island
Pritchett
Middle Brook
Gambo
Dead Cove
MAN PEAK
Cat Gut
Rocky Bay
Cat Bay
Willis Island
Morris I
Northwest Arm
Mint Brook
Mitsons Pond
Northwest Pond
Saunders Cove
Alexander Bay
Glovertown
South
Traytown
Sandringham
St. Chads
Eastport
Happy Adventure
Sandy Cove
GERRARD HILL
LOUIL HILLS
BONAVISTA NORTH DIST
BONAVISTA SOUTH DIST
Parsons Pond
Swale Island
Inner
Drift
Zone
Outer
Drift
Zone
MT STANFORD
TERRA NOVA NATIONAL PARK
DARK HARBOUR HILL
BREAD COVE HILLS
Fire Lookout
Dumpling Cove
OCHRE PIT HILL
Saunders Pond
Georges Pond
Terra Nova
Charlottetown
Musgravetown
Bunyan's Cove
Northwest Pond
Bloomfield
Cannings Cove
Winter Brook
Sweet Bay
Matthew Cove
Great Chance Hbr
Princeton
Southern Harbour
Charleston
Trinity
Lockston
Lockston Prov Park
Red Cliff
Kings Cove
Knights Cove
Stock Cove
Plate Cove East
Plate Cove West
POWDER COVE HILL
INDIAN LOOKOUT
Upper Amherst Cove
Elliston
Spillars Cove
GREEN RIDGE
BURNT RIDGE
Port Union
Catalina
SKERRIES HILL
Halfway Pond
Champney's West
English Harbour
CANADIAN NATIONAL
Trans Canada Highway
1
10
24
25
26
27
37
39
40
96
111


49° 00'
45'
30'
Northwest Arm
Powell Cove
Trinity
Lewis Island
40
Deer Island
Pitt Sound Island
Cottel Island
Lakeman I
Beaches Hd
MAN PEAK 544
Tumbler I
Willis Island
Rocky Bay
Hail
Morris I
Long Reach
Burnside
St. Chads
37
GERRARD HILL
39
Linds Pd
Barrow Hbr
Sandringham
Eastport
Happy Adventure
Sandy Cove
BONAVISTA NORTH DIST
BONAVISTA SOUTH DIST
LOUIL HILLS
Swale Island
Buckley Cove
MT STANFORD
NATIONAL PARK
HARBOUR HILL
Fire Lookout
Dumpling Cove
OCHRE PIT HILL
Great Chance Hbr
Sweet Bay
Matthew Cove
Winter Brook
Musgravetown
96
Northwest Pond
Princeton
INDIAN LOOKOUT
Charleston
Southern Bay
27
Big Codger Pond
Goose Cove
Tickle Cove
Red Cliff
Broad Cove
Lewis Pond
Kings Cove
Knights Cove
Stock Cove
10
Plate Cove East
Plate Cove
BOWSER COVE HILL
26
Trinity Pond
Television Lockston Prov Park
Lockston
Champney's
Champney's West
English Harbour
Upper Amherst Cove
Newmans Cove
25
Catalina
Long Pond
Port Union
SKERRIES HILL
Melrose
Halfway Pond
24
CANADIAN NATIONAL
Spillars Cove
GREEN RIDGE
Elliston
BURNT RIDGE
23
Maberly
Little
R

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR



Inner Drift Zone
Outer Drift Zone
Saunders Cove
Northwest Pond
Alexanders Bay
Glovertown
South
Traytown
LOUIL HILLS
St. Chads
Salvage
GERRARDS HILL
Sandringham
Eastport
Happy Adventure
Sandy Cove
Linds Pd
Barrow Hbr
BONAVISTA NORTH DIST
BONAVISTA SOUTH DIST
Swale Island
Parsons Pond
Buckley Cove
MT STANFORD
TERRA NOVA NATIONAL PARK
PARK HARBOUR HILL
BREAD COVE HILLS
Saunders Pond
Georges Pond
Terra Nova
TERRA NOVA NATIONAL PARK
Fire Lookout
Dumpling Cove
OCHRE PIT HILL
Great Chance Hbr
Charlottetown
Canning Cove
Jamestown
Winter Brook
Portland
Musgravetown
Bunyan's Cove
Northwest Pond
Bloomfield
Southwest Arm
Lethbridge
Port Blandford
Salmon Pond
Mollyguajeck Lake
Saltons Pond
Matthews Pond
Dalton
Juniper Pds
Dam Pd
Ocean Pond
TRINITY NORTH DISTRICT
1083 Fire
Gull Pond
Big Pond
Thorburn Lake
Ryders Brook
Georges Brook
Trans Canada Highway
Rocky Pond
Barton
Milton
Harcourt
Gin Cove
Monroe
Mills Siding
Clifton
New Bury Cove
Shoal Harbour Pond
Snooks Harbour
Aspey Brook
Fagans Pond
Petley
Elliott's Cove
Britannia
GINNIGAN HILL
Deer Harbour
RANDOM ISLAND
Weybridge
Lady Cove
Hickman's Harbour
Deep Bight
Adeytown
Middle Pond
Sleigh Pond
Island Pond
Radio
Red Indium Pond
Tilting Cove
Sugar Cove
Broad Cove
Lewis Pond
Kings Cove
Red Cliff
Knights Cove
Stock Cove
Upper Amherst Cove
Newmans Cove
Catalina
Port Union
SKERRIES HILL
Melrose
Plate Cove East
Plate Cove
POWDER COVE HILL
Sweet Bay
NUT HILL
Matthew Cove
Summerville
Princeton
INDIAN LOOKOUT
Trinity
Pond
Television Lockston Pros Park
Lockston
Port Rexton
Champney's
Champney's West
English Harbour
Charleston
Southern Harbour
Goose Cove
Trinity
BONAVISTA NORTH NATIONAL TRINITY
Rocks Pd
Fire Lookout
Blue Gull Pond
Puddle Duck Pond
Cross Pd
Trinity Pond
Big Codfish Pond
Northeast Pond
Midway Pd
New Bonaventure
Kerleys Harbour
Old Bonaventure
Rapids
Popes Harbour
Popes Harbour Pond
British Harbour
Delby Cove
TREBLE RANGE
Lady Pond
Second Pond
First Pd
Fairhaven
BAKERS LOAF
CANADIAN NATIONAL
Halfway Pond
Long Pond
30'
15'
30'
15'
54°00'
45'
30'
15'


Bonavista North Dist
Bonavista South Dist
Swale Island
Terra Nova National Park
Zone
Bread Cove Hills
Mt Stafford
Ochre Pit Hill
Musgravetown
Bloomfield
Northwest Pond
Clarenville
Shoal Harbour
Trinity
Port Union
Catalina
Elliston
Spillars Cove
Green Ridge
Burnt Ridge
Upper Amherst Cove
Knights Cove
Stock Cove
Kings Cove
Red Cliff
Plate Cove
Princeton
Southern
Indian Lookout
Lockston
Champney's West
English Harbour
Goose Cove
Ocean Pond
Lady Pond
Old Bonaventure
New Bonaventure
Popes Harbour
Delby Cove
Bakers Loaf
Georges Brook
Milton
Harcourt
Gin Cove
Monroe
Britannia
Hickman's Harbour
Weybridge
Lady Cove
Random Island
Snooks Harbour
Elliott's Cove
Mills Siding
Old Perlican
Daniels Cove
Bay
R
1
2
Canadian
Trinity
Bonavista North
Trinity North
30'
15'
45'
30'
15'
53°00'
45'

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

SURFICIAL HYDROGEOLOGY

HYDROGEOLOGY OF BONAVISTA BAY AREA

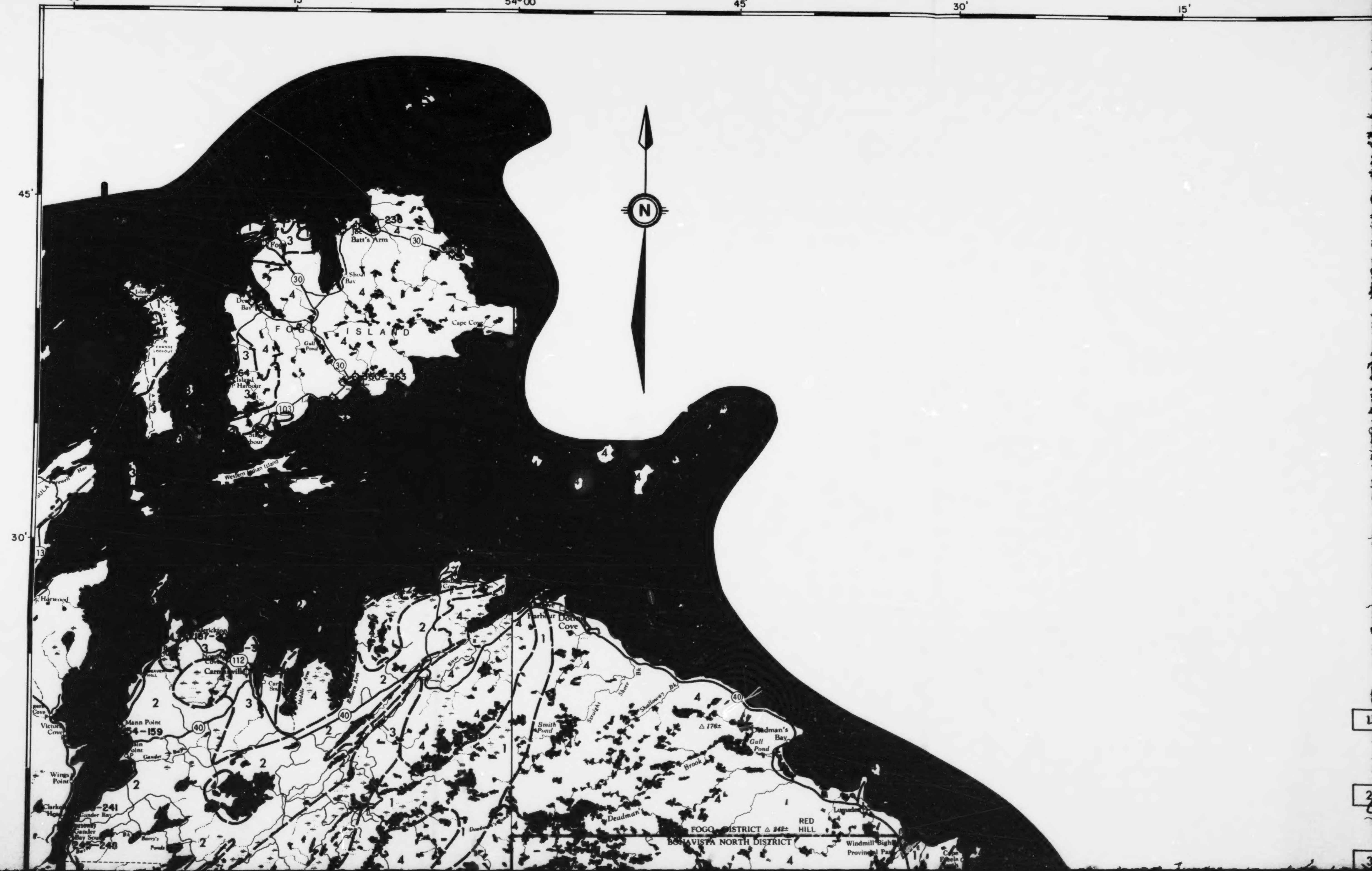
1981

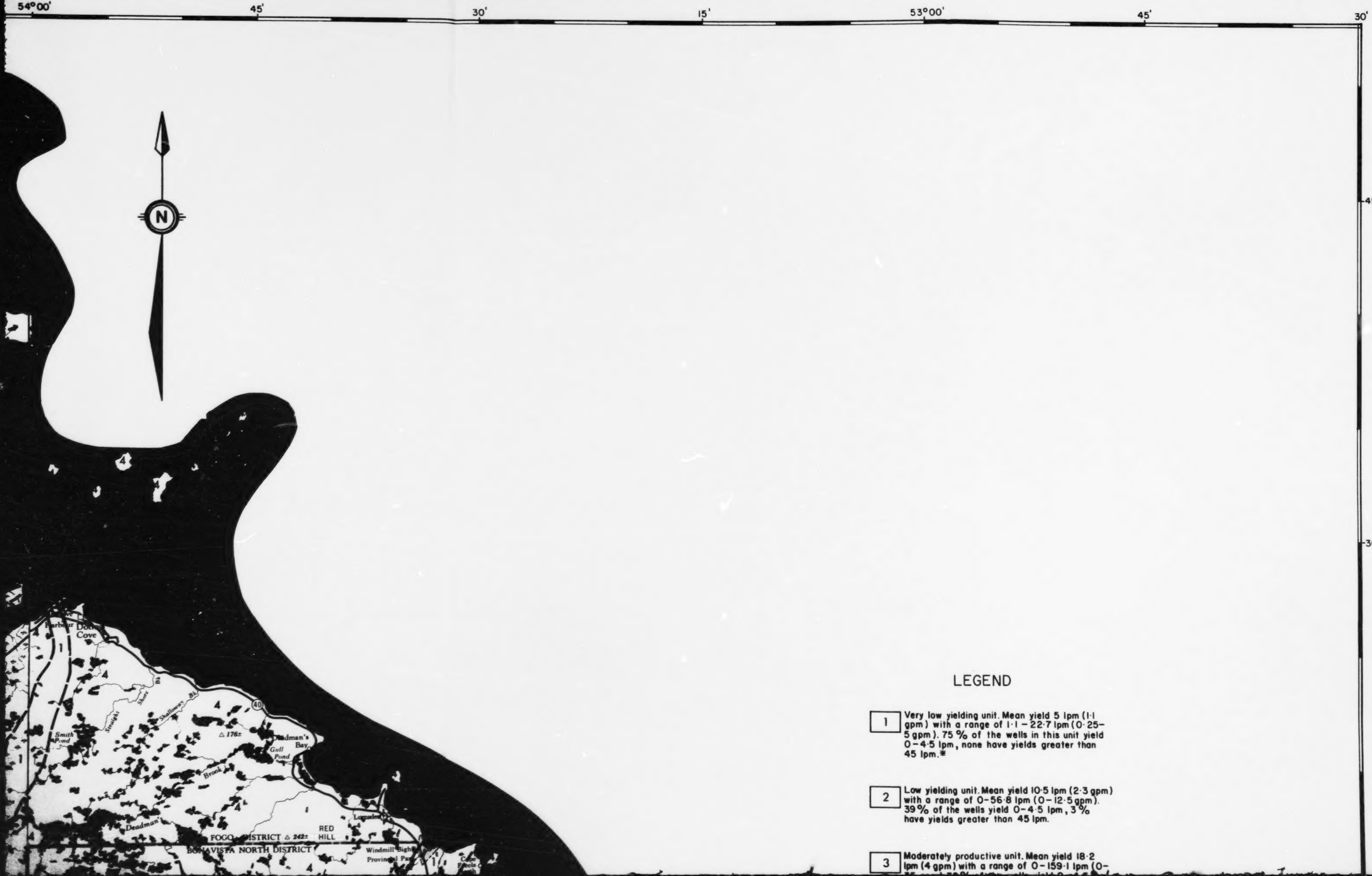
MAP 2

Scale 1: 250,000

5
0
5
10
15
20
25
KILOMETRES

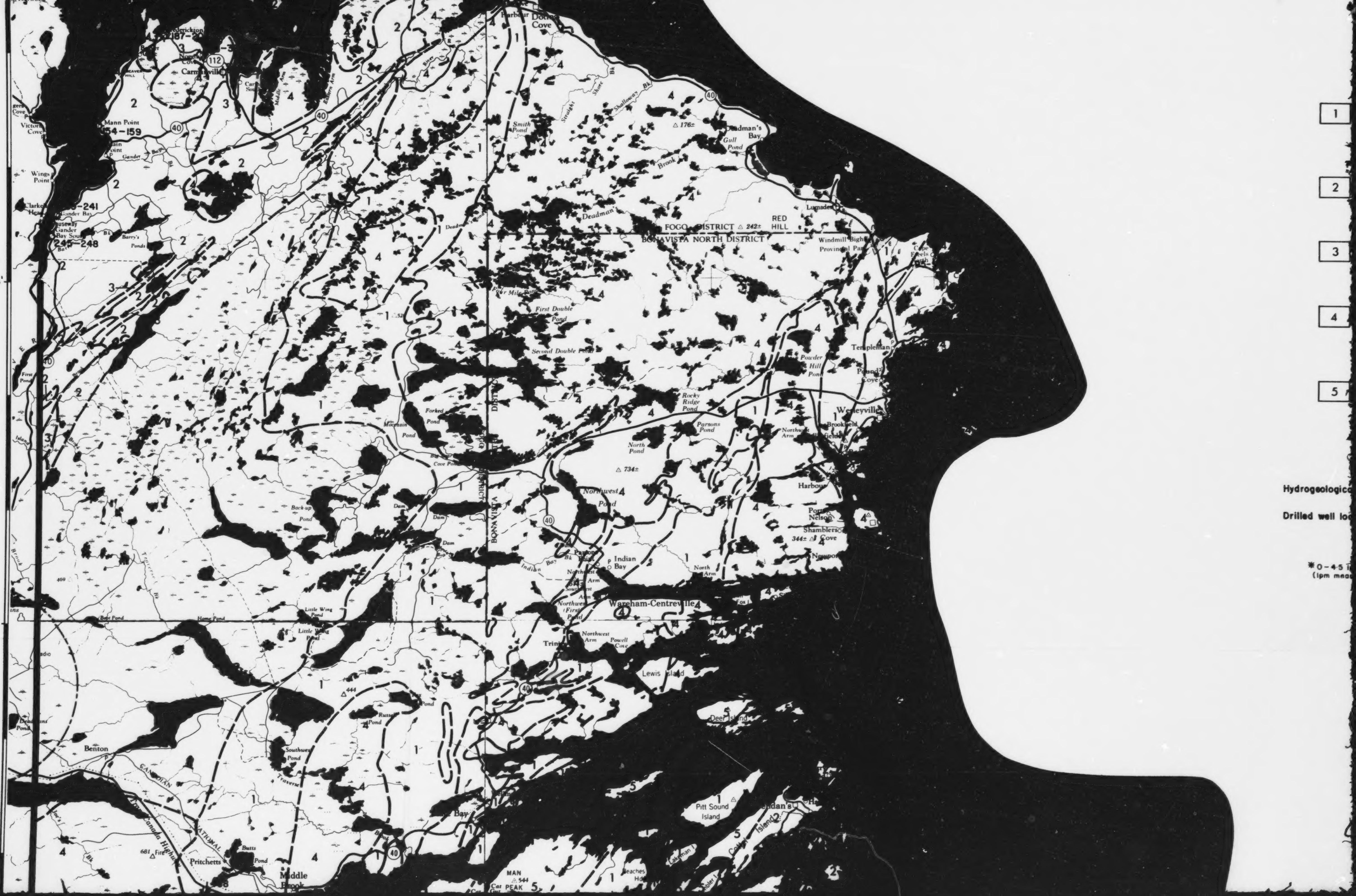
NOLAN, DAVIS & ASSOCIATES LIMITED

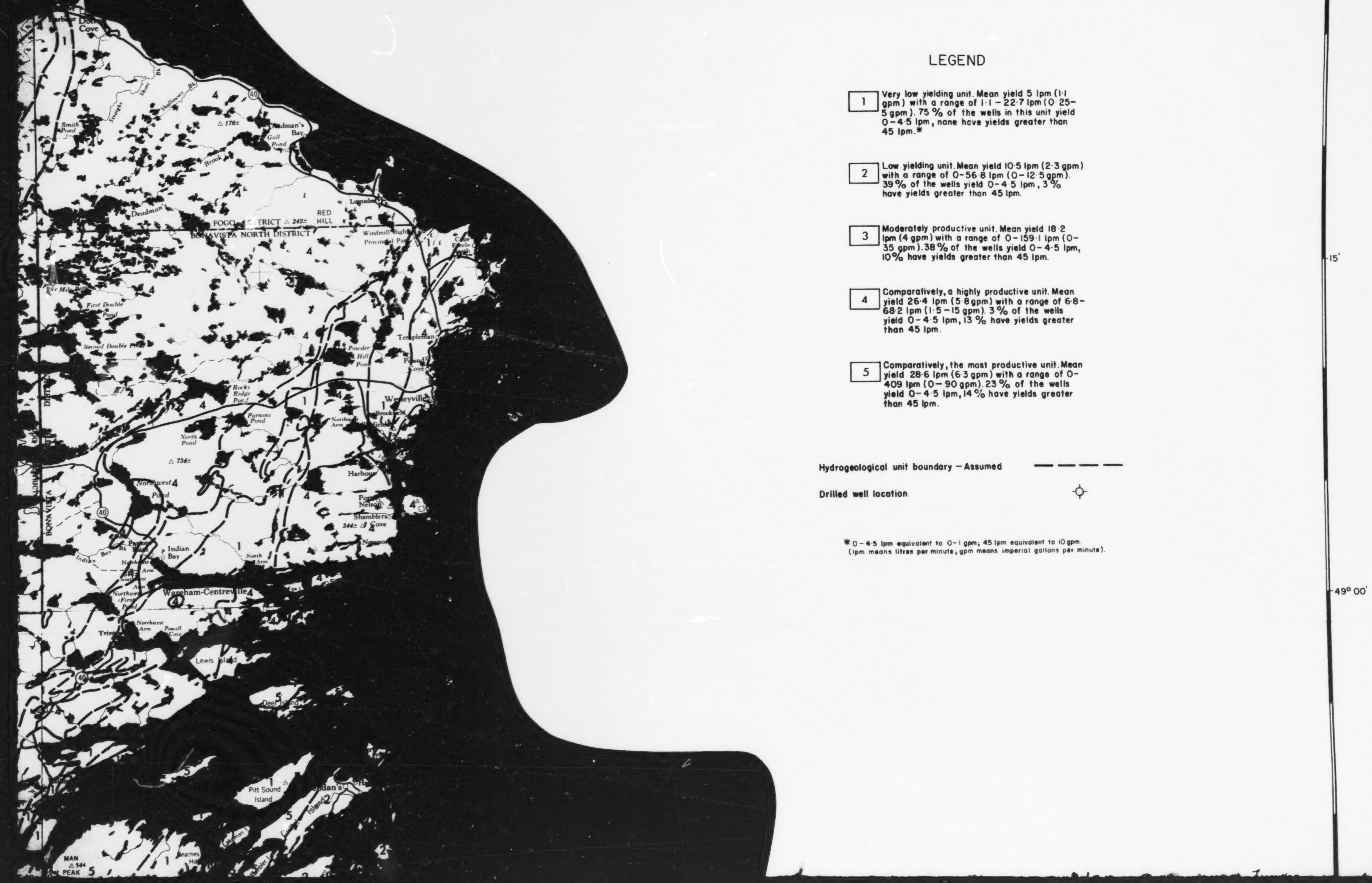

30'
15'
54°00'
45'
30'
15'
45'
30'
N
Fogo
Joe Batt's Arm
230
30
Shoal Bay
Deep Bay
FOGO ISLAND
Gull Pond
Cape Cove
264
Island Harbour
360-363
103
Stag Harbour
CHANGE LOOKOUT
Western Indian Island
13
Harwood
Carmanville
112
Mann Point
154-159
40
Victoria Cove
Wings Point
Clarke's Head
Gander Bay
Gander Bay South
241
248
Barry's Ponds
Middle Arm
Eastern Arm
River
Harbour
Doting Cove
Smith Pond
Straight Shore Bk
Shalloway Bk
△ 176±
Deadman's Bay
Gull Pond
Brook
Deadman's
FOGO DISTRICT
△ 242±
RED HILL
BONAVISTA NORTH DISTRICT
Lumsden
Windmill Bight Provincial Park
Cape Freels
1
2
3
4


54°00'
45'
30'
15'
53°00'
45'
30'
45'
30'
N
4
Harbour
Cove
1
4
Bk
Shore
Straight
Shalloway Bk
4
40
△ 176±
Deadman's Bay
Gull Pond
Smith Pond
1
Brook
4
Deadman's
1
Lumsden
RED HILL
FOGO DISTRICT △ 242±
BONAVISTA NORTH DISTRICT
Windmill Bight
Provincial Park
4
1
Cape Freels

LEGEND

1	Very low yielding unit. Mean yield 5 lpm (1·1 gpm) with a range of 1·1 – 22·7 lpm (0·25–5 gpm). 75 % of the wells in this unit yield 0–4·5 lpm, none have yields greater than 45 lpm.*
2	Low yielding unit. Mean yield 10·5 lpm (2·3 gpm) with a range of 0–56·8 lpm (0–12·5 gpm). 39% of the wells yield 0–4·5 lpm, 3% have yields greater than 45 lpm.
3	Moderately productive unit. Mean yield 18·2 lpm (4 gpm) with a range of 0–159·1 lpm (0–


15'
49°00'
FOGO DISTRICT
BONAVISTA NORTH DISTRICT
BONAVISTA
RED HILL
Carmanville
Mann Point
154-159
Wings Point
Clarkes Head
Gander Bay
245-248
Victoria Cove
Deadman's Bay
Gull Pond
Smith Pond
Lumsden
Windmill Bight Provincial Park
Cape Freels
Templeman
Powder Hill Pond
Pound Cove
Wesleyville
Brookfield
Badger's Quay
Northwest Arm
Rocky Ridge Pond
Parsons Pond
North Pond
Northwest Pond
First Double Pond
Second Double Pond
Forked Pond
Mountain Pond
Back-up Pond
Indian Bay
North Arm
Wareham-Centreville
Trinity
Lewis Island
Deer Island
Pitt Sound Island
Cottel Island
Port Nelson
Shamblers Cove
Newport
Little Wing Pond
Home Pond
Benton
Pritchetts
Middle Brook
Butts Pond
Russell Pond
Southwest Pond
Trans-Canada Highway
Canadian National
Beaches
MAN PEAK
Four Mile Pond
Dam
40
112
1
2
3
4
5
Hydrogeologic
Drilled well lo
*0–4.5
(lpm mea

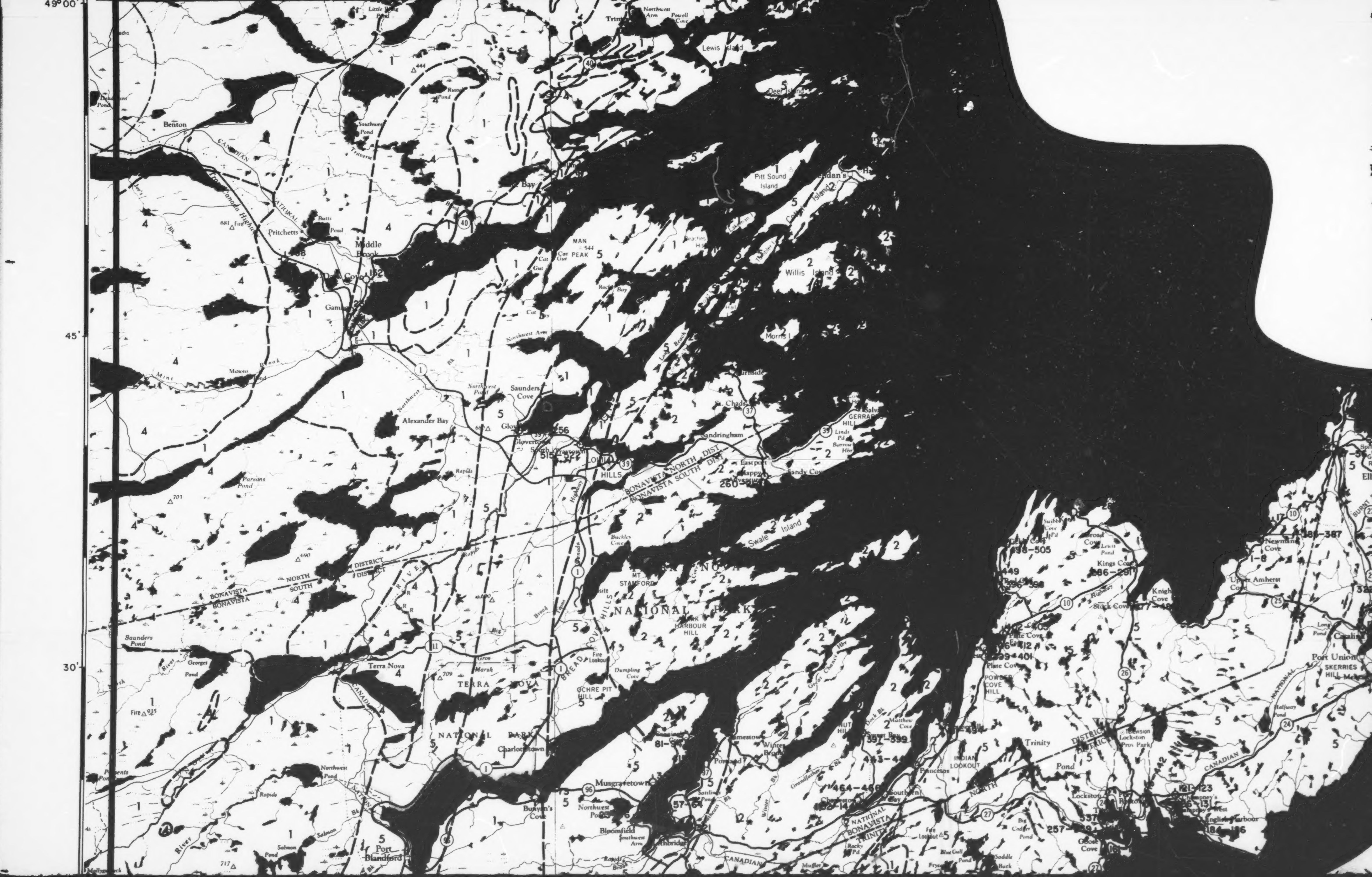

Cove
Smith Pond
Gull Pond
Dadman's Bay
Brook
Deadman
FOGO DISTRICT
△ 242±
RED HILL
BONAVISTA NORTH DISTRICT
Lumsden
Windmill Bight Provincial Park
Cape Freels
Four Mile Pond
First Double Pond
Second Double Pond
Templeman
Powder Hill Pond
Pound Cove
Rocky Ridge Pond
Parsons Pond
Wesleyville
Brookfield
North Arm
North Pond
△ 734±
△ 176±
Harbour
Pond Nelson
Shamblers Cove
344±
Newport
Northwest Pond
Indian Bay
North Arm
Wareham-Centreville
Northwest Arm
Powell Cove
Lewis Island
Deer Island
Pitt Sound Island
Newman's
Cottel Island
Beaches
MAN PEAK △ 544
BONAVISTA
40
1
2
3
4
5
15'
49° 00'

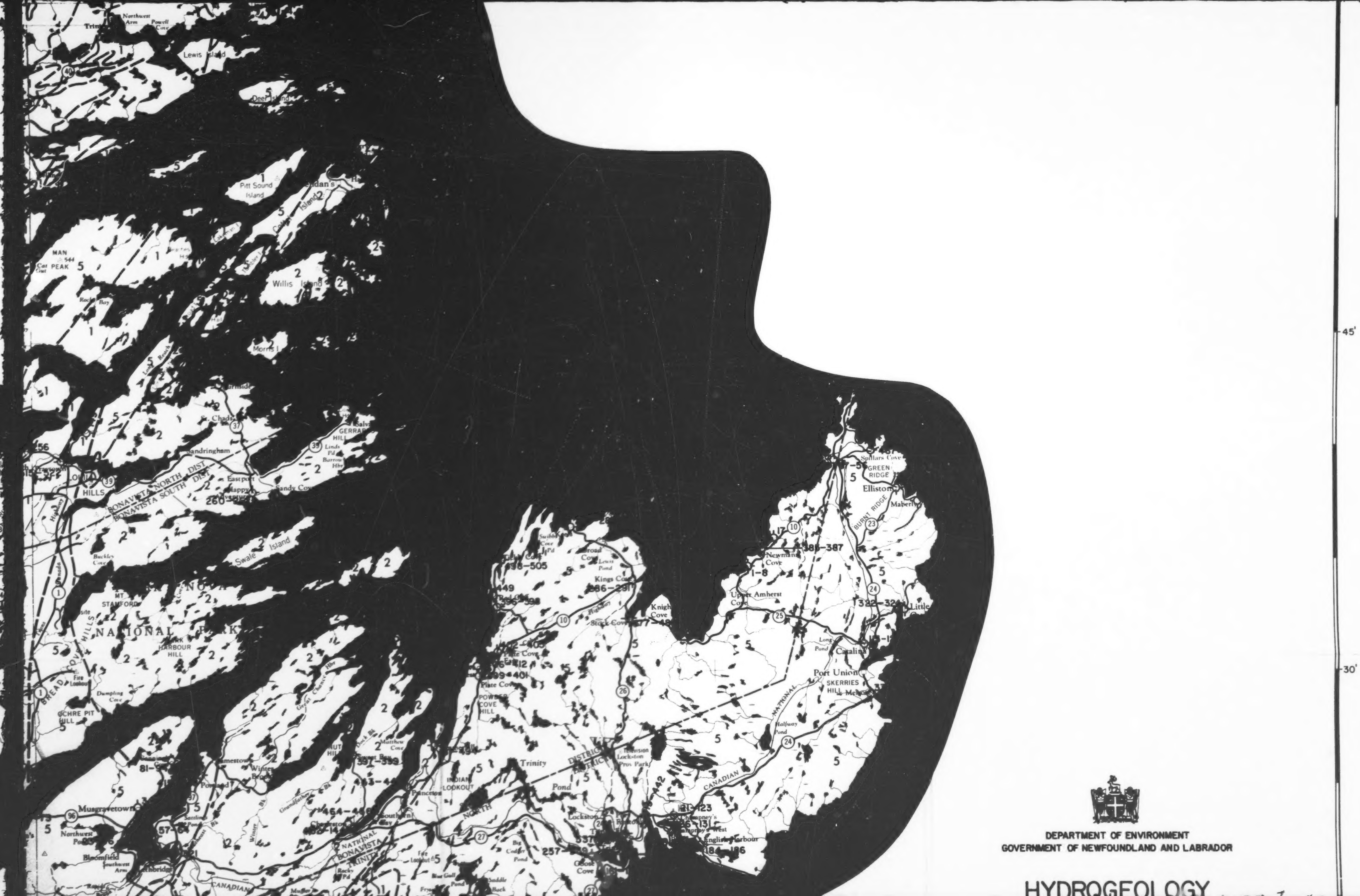
LEGEND

1	Very low yielding unit. Mean yield 5 lpm (1·1 gpm) with a range of 1·1 – 22·7 lpm (0·25–5 gpm). 75 % of the wells in this unit yield 0 – 4·5 lpm, none have yields greater than 45 lpm.*
2	Low yielding unit. Mean yield 10·5 lpm (2·3 gpm) with a range of 0–56·8 lpm (0 – 12·5 gpm). 39 % of the wells yield 0 – 4·5 lpm, 3 % have yields greater than 45 lpm.
3	Moderately productive unit. Mean yield 18·2 lpm (4 gpm) with a range of 0 – 159·1 lpm (0–35 gpm). 38 % of the wells yield 0 – 4·5 lpm, 10 % have yields greater than 45 lpm.
4	Comparatively, a highly productive unit. Mean yield 26·4 lpm (5·8 gpm) with a range of 6·8–68·2 lpm (1·5 – 15 gpm). 3 % of the wells yield 0 – 4·5 lpm, 13 % have yields greater than 45 lpm.
5	Comparatively, the most productive unit. Mean yield 28·6 lpm (6·3 gpm) with a range of 0–409 lpm (0 – 90 gpm). 23 % of the wells yield 0 – 4·5 lpm, 14 % have yields greater than 45 lpm.

Hydrogeological unit boundary – Assumed	— — — —
Drilled well location	⌖

* 0 – 4·5 lpm equivalent to 0 – 1 gpm; 45 lpm equivalent to 10 gpm.
(lpm means litres per minute; gpm means imperial gallons per minute).

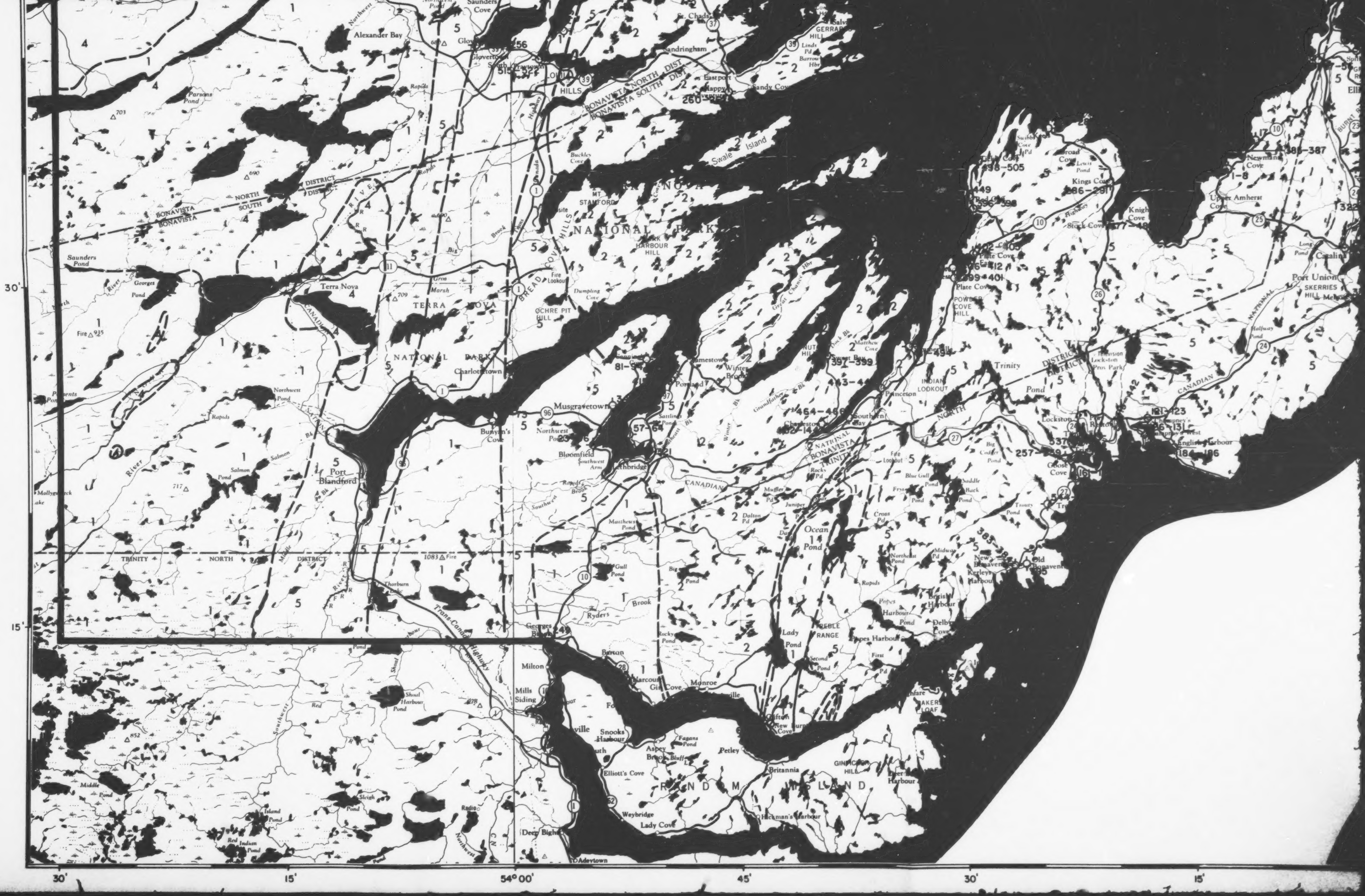

49°00'
45'
30'
Trinity
Northwest Arm
Powell Cove
Lewis Island
Deer Island
Little Pond
Benton
Dead Mans Pond
Russell Pond
Southwest Pond
Traverse
Trans Canada Highway
CANADIAN NATIONAL
Pitt Sound Island
Cottel Island
Willis Island
Morris I
Butts Pond
Pritchetts
Middle Brook
Dark Cove
Gambo
681 Fire
MAN PEAK 544
Cat Gut
Rocky Bay
Cat Bay
Northwest Arm
Mint Brook
Matsons Pond
Northwest Pond
Saunders Cove
Alexander Bay
Glovertown
Glovertown South
Traytown
Louil Hills
St. Chads
Burnside
Sandringham
Eastport
Happy Adventure
Sandy Cove
GERRARD HILL
Linds Pd
Barrow Hbr
BONAVISTA NORTH DIST
BONAVISTA SOUTH DIST
Parsons Pond
703
Rapids
Swale Island
Buckley Cove
MT STANFORD
TERRA NOVA
NATIONAL PARK
ARK HARBOUR HILL
690
DISTRICT
BONAVISTA NORTH
BONAVISTA SOUTH
Saunders Pond
Georges Pond
Terra Nova
709
Gros Marsh
Fire Lookout
Dumpling Cove
OCHRE PIT HILL
BREAD COVE HILLS
Great Chance Hbr
Charlottetown
Fire 935
Northwest Pond
Rapids
Musgravetown
Bunyan's Cove
Northwest Pond
Bloomfield
Southwest Arm
Lethbridge
Port Blandford
Salmon Pond
717
Jamestown
Winter Brook
Portland
Sattling Pond
Matthew Cove
Sweet Bay
Princeton
Southern Bay
Charleston
NATIONAL BONAVISTA TRINITY
INDIAN LOOKOUT
Trinity
Pond
Lockston
Port Rexton
Champney's West
English Harbour
Goose Cove
Big Cod Pond
Blue Gull Pond
Saddle Back
Fire Lookout
Rocky Pd
CANADIAN
Stock Cove
Plate Cove
POWDER COVE HILL
Broad Cove
Lewis Pond
Kings Cove
Knight Cove
Newmans Cove
Upper Amherst Cove
Long Pond
Catalina
Port Union
SKERRIES HILL
Halfway Pond
Television Lockston Prov Park
DISTRICT
NORTH
Elliston
1
4
5
2
40
1
37
39
10
25
26
24
27
96
111
256
260
498-505
286-291
381-387
81-91
397-399
464-466
57-64
257
337
121-123
184-186



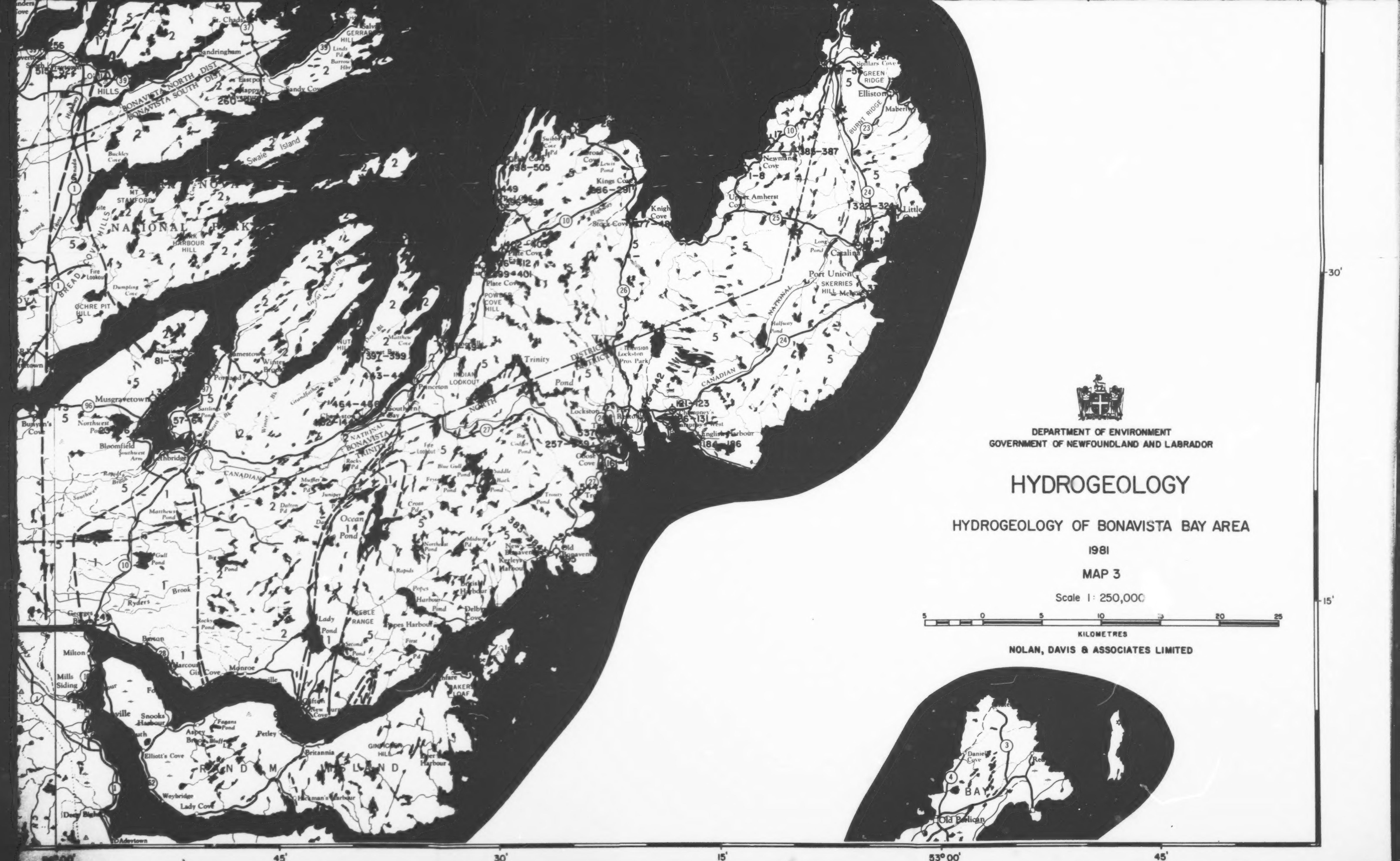
Northwest Arm
Powell Cove
Lewis Island
Deer Island
Pitt Sound Island
Willis Island
Morris I.
MAN 544 PEAK
Rocky Bay
Swale Island
Buckley Cove
MT STANFORD
NATIONAL PARK
HARBOUR HILL
BREAD COVE HILLS
OCHRE PIT HILL
Dumpling Cove
Sandringham
Eastport
Sandy Cove
GERRARD HILL
BONAVISTA NORTH DIST
BONAVISTA SOUTH DIST
LOOK HILLS
260
Spillars Cove
GREEN RIDGE
Elliston
Maberly
BURNT RIDGE
Newmans Cove
386-387
Upper Amherst Cove
322-324
Little
Knight Cove
Kings Cove
286-291
Broad Cove
Lewis Pond
Stock Cove
Long Pond
Catalina
Port Union
SKERRIES HILL
Melrose
Halfway Pond
NATIONAL
CANADIAN
Plate Cove
POWDER COVE HILL
399-401
Trinity
Pond
Lockston
Lockston Prov Park
Champney's West
English Harbour
184-186
121-123
126-131
INDIAN LOOKOUT
Princeton
Musgravetown
Northwest Pond
Bloomfield
Southwest Arm
Winter Brook
Portland
Matthew Cove
331-333
464-466
Charleston
NORTH
BONAVISTA
TRINITY
Fire Lookout
Big Cooper Pond
257
Goose Cove
Blue Gull Pond
Saddle Back
Rocky Pd
81
57
DISTRICT
45'
30'

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

HYDROGEOLOGY



Alexander Bay
Saunders Cove
Glovertown
St. Chads
Salvage
Sandringham
Eastport
Happy Adventure
Sandy Cove
Gerrard Hill
Linds Pd
Burrow Hbr
Parsons Pond
BONAVISTA NORTH DIST
BONAVISTA SOUTH DIST
Swale Island
Buckley Cove
Saunders Pond
Georges Pond
Terra Nova
TERRA NOVA
NATIONAL PARK
MT STANFORD
NEWMAN SOUND
HARBOUR HILL
BREAD COVE HILLS
Fire Lookout
Dumpling Cove
OCHRE PIT HILL
Charlottetown
Northwest Pond
Salmon Pond
Port Blandford
Bunyan's Cove
Musgravetown
Northwest Pond
Bloomfield
Lethbridge
Southwest Arm
Matthews Pond
Portland
Jamestown
Winter Brook
Sweet Bay
Charleston
Southern Bay
Princeton
INDIAN LOOKOUT
Trinity
Lockston
Port Rexton
Goose Cove
Trinity Pond
Lewis Pond
Kings Cove
Broad Cove
Keels
Plate Cove
POWDER COVE HILL
Knights Cove
Stock Cove
Upper Amherst Cove
Newmans Cove
Port Union
SKERRIES HILL
Catalina
Melrose
Champney's West
English Harbour
Halfway Pond
Ocean Pond
Dalton Pd
Muffler Pd
Rocky Pd
Blue Gull Pond
Saddle Back Pond
Cross Pd
Northeast Pond
Midway Pd
New Bonaventure
Kerleys Harbour
Old Bonaventure
British Harbour
Pepes Harbour
Delby Cove
Lady Pond
Second Pond
TREBLE RANGE
Gull Pond
Big Pond
Ryders Brook
Thorburn Lake
Georges Brook
Milton
Mills Siding
Barton
Harcourt
Gin Cove
Monroe
Clifton
New Burnt Cove
Snooks Harbour
Aspey Brook
Fagans Pond
Petley
Britannia
GINHOOP HILL
Elliott's Cove
RANDOM ISLAND
Weybridge
Lady Cove
Hickman's Harbour
Deep Bight
Adeytown
Shoal Harbour Pond
Middle Pond
Sleigh Pond
Island Pond
Red Indian Pond
Trans-Canada Highway
TRINITY NORTH DISTRICT
BONAVISTA NATIONAL TRINITY
CANADIAN NATIONAL
1083 Fire
935 Fire
30'
15'
30'
15'
54°00'
45'
30'
15'


Sandringham
Eastport
Sandy Cove
Swale Island
TERRA NOVA NATIONAL PARK
BONAVISTA NORTH DIST.
BONAVISTA SOUTH DIST.
Spillars Cove
GREEN RIDGE
Elliston
Maberly
BURNT RIDGE
Newmans Cove
Upper Amherst Cove
Kings Cove
Knight Cove
Stock Cove
Catalina
Port Union
SKERRIES HILL
Melrose
Little
Trinity
Television Lockston Prov Park
Lockston
Champney's
Champney's West
English Harbour
Goose Cove
Old Bonaventure
New Bonaventure
Kerleys Harbour
Delby Cove
Plate Cove
POWDER COVE HILL
INDIAN LOOKOUT
Princeton
Southern Bay
Charleston
Jamestown
Winter Brook
Musgravetown
Bunyan's Cove
Northwest Pond
Bloomfield
Lethbridge
Georges Brook
Milton
Mills Siding
Ryders
Monroe
Gin Cove
Snooks Harbour
Elliott's Cove
Britannia
Petley
Lady Cove
Weybridge
Deep Bight
Adeytown
RANDOM ISLAND
Ocean Pond
Lady Pond
Daniels Cove
Old Perlican
BAY
CANADIAN NATIONAL
30'
15'
45'
30'
15'
53°00'
45'

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

HYDROGEOLOGY

HYDROGEOLOGY OF BONAVISTA BAY AREA

1981

MAP 3

Scale 1: 250,000

5 0 5 10 15 20 25
KILOMETRES

NOLAN, DAVIS & ASSOCIATES LIMITED